TM 5-3431-228-14

TECHNICAL MANUAL

**OPERATOR, ORGANIZATIONAL,
DIRECT SUPPORT AND GENERAL SUPPORT
MAINTENANCE MANUAL**

WELDING MACHINE, ARC: AC/DC, 300 AMP, TRANSFORMER RECTIFIER; CONSTANT CURRENT, BASE MOUNTED (EUTECTIC CORP. MODEL MD301 FED) FSN 3431-235-4728

This copy is a reprint which includes current pages from Changes 1 and 2.

HEADQUARTERS, DEPARTMENT OF THE ARMY
SEPTEMBER 1970

SAFETY PRECAUTIONS

BEFORE OPERATION

Always wear a full face coverage welding helmet with approved welding lens (No. 10 or darker) to protect eyes and face.

Never strike an arc in the presence of other persons whose eyes are not shielded.

Wear heavy gloves and protective clothing shielding the entire body from hot metal spatter and intense ultraviolet rays.

Provide adequate ventilation when welding in confined areas.

Assure that electrode holder is fully insulated, and welding cables are free of worn or frayed insulation.

See that the ground terminal lug is connected through the input cable or by separate conductor to the power system ground. An ungrounded machine can cause death by electrocution to personnel coming in contact with it.

Do not reposition the voltage bars while power source is connected to the machine. To do so could cause a serious electrical shock and possible death.

DURING OPERATION

Do not perform any welding operations in the presence of vapors from trichloroethylene or other halogenated solvents. Ultraviolet radiation from the arc creates rapid vapor decomposition resulting in dangerously high concentrations of noxious fumes, including phosgene. Greatest noxious fume concentrations are produced by argon, when utilizing the inert gas shielded method of welding in the presence of these vapors.

Do not open the welder cabinet without turning off the POWER switch and disconnecting power.

In case of fire do not throw water on any electrical device. Disconnect ac power and use a foam extinguisher or sand to smother the flame.

Do not make or break any connections or perform any maintenance while the welding machine is in operation. The high voltage created by this machine can cause death by electrocution.

Do not come in contact with the electrode, terminal, or holder while the machine is in operation. The high voltage generated by the machine can cause death by electrocution.

Be very careful when the unit or surrounding area is wet or damp. Coming in contact with a wet or damp unit can cause a serious electrical shock and possible death.

When malfunction of the selenium rectifier occurs, thoroughly ventilate the area to prevent inhalation of poisonous fumes. Do not handle the damaged rectifier while it is warm so as not to absorb poisionous selenium oxide compound through the skin. Failure to observe this warning can result in serious injury or possible death.

AFTER OPERATION

When making a test on the high-frequency transformer, make sure that the transformer is on an insulated bench. Do not touch an activated transformer or the wires leading from it. To do so may cause a serious electrical shock or possible death to personnel performing the test.

Short the capacitor connections together before removal. Failure to do this may result in a serious electrical shock.

TM 5-3431-228-14
TO 34W4-102-1
C 1

CHANGE
No. 1

DEPARTMENTS OF THE ARMY
AND THE AIR FORCE
WASHINGTON, D.C., *26 April 1971*

Operator, Organizational Direct Support and General Support Maintenance Manual

WELDING MACHINE, ARC: AC/DC, 300 AMP TRANSFORMER RECTIFIER; CONSTANT CURRENT, BASE MOUNTED (EUTECTIC CORP. MODEL MD301FED) FSN 3431-235-4728

TM 5-3431-228-14, 30 September 1970, is changed as follows:
Cover and page i are changed to add Air Force Technical Order number.
Throughout this manual where the abbreviation vac is used, change to read "Volts a.c.".
Page 6-2, paragraph 6-6, TM reference in this paragraph should be corrected to read "TM 5-3431-228-35P".
Page A-1, reference A-6; correct second line TM reference to read "TM 740-90-1".

By Order of the Secretaries of the Army and the Air Force:

W. C. WESTMORELAND,
General, United States Army,
Chief of Staff.

Official:
VERNE L. BOWERS,
Major General, United States Army,
The Adjutant General.

JOHN D. RYAN, *General, USAF*
Chief of Staff

Official:
DWIGHT W. COVELL, *Colonel, USAF*
Director of Administration

Distribution:
To be distributed in accordance with DA Form 12-25, Section I (qty rqr block No. 181) Operator Maintenance requirements for Equipment Welding Machine.

*U.S. GOVERNMENT PRINTING OFFICE: 1982-0-361-663/361

TM 5-3431-228-14
TO 34W4-102-1
C2

Change No. 2

DEPARTMENTS OF THE ARMY
AND THE AIR FORCE
Washington, D.C., *27 June 1978*

Operator, Organizational, Direct Support, and General Support Maintenance Manual WELDING MACHINE, ARC: AC/DC, 300 AMP, TRANSFORMER RECTIFIER; CONSTANT CURRENT, BASE MOUNTED (EUTECTIC CORP. MODEL MD301 FED) FSN 3431-235-4728

TM 5-3431-228-14, 30 September 1970, is changed as follows:
Page B-1. APPENDIX B is superseded as follows:

APPENDIX B
BASIC ISSUE-ITEMS-LIST-AND ITEMS TROOP INSTALLED OR AUTHORIZED LIST

Section I. INTRODUCTION

B-1. Scope

This appendix lists items required by the operator for operation of the welding machine.

B-2. General

This list is divided into the following sections:

a. Basic Issue Items List—Section II. Not applicable.

b. Items Troop Installed or Authorized List—Section III. A list of items in alphabetical sequence, which at the discretion of the unit commander may accompany the welding machine. These items are NOT SUBJECT TO TURN-IN with the welding machine when evacuated.

B-3. Explanation of Columns

The following provides an explanation of columns in the tabular list of Basic Issue Items List, Section II, and Items Troop Installed or Authorized List, Section III.

a. Source, Maintenance and Recoverability Code(s) (SMR): (Not applicable).

b. Federal Stock Number. This column indicates the Federal stock number assigned to the item and will be used for requisitioning purposes.

c. Description. This column indicates the Federal item name and any additional description of the item required.

d. Unit of Measure (U/M). A two character alphabetic abbreviation indicating the amount or quantity of the item upon which the allowances are based, e.g., ft, ea, pr, etc.

e. Quantity Furnished with Equipment (BIIL). (Not applicable).

f. Quantity Authorized (Items Troop Installed or Authorized). This column indicates the quantity of the item authorized to be used with the equipment.

Section III. ITEMS TROOP INSTALLED OR AUTHORIZED LIST

(1) SMR code	(2) Federal stock number	(3) Description Ref. No & Mfr code	Usable on code	(4) Unit of meas	(5) Qty auth
	7520-559-9618	Case, Manual		EA	1
	4720-990-7702	Hose, Auxiliary Fuel		EA	1

By Order of the Secretary of the Army:

CREIGHTON W. ABRAMS
General, United States Army
Chief of Staff

Official:
VERNE L. BOWERS
Major General, United States Army
The Adjutant General

Distribution:
To be distributed in accordance with DA Form 12-25D (qty rqr block No. 1058), Organizational maintenance requirements for Generator Sets: 60 KW, 400 HZ, Precise Power.

GPO 911-635

U.S. GOVERNMENT PRINTING OFFICE: 1982-0-361-663/362

TECHNICAL MANUAL
No. 5-3431-228-14

HEADQUARTERS,
DEPARTMENT OF THE ARMY
Washington, D. C., *30 September 1970*

OPERATOR, ORGANIZATIONAL, DIRECT SUPPORT AND GENERAL SUPPORT MAINTENANCE MANUAL

WELDING MACHINE, ARC: AC/DC, 300 AMP, TRANSFORMER RECTIFIER; CONSTANT CURRENT, BASE MOUNTED (EUTECTIC CORP. MODEL MD301 FED) FSN 3431-235-4728

LIST OF ILLUSTRATIONS

CHAPTER 1
INTRODUCTION

Section I. GENERAL

1-1. Scope

This publication contains descriptive data and information for installing, operating, and maintaining Model MD301 FED Inert Shielded Arc Welding Machine. Chapter 1 contains descriptive data. Chapter 2 contains instructions for installation and operation. Chapters 3 through 7 contain information on preventive maintenance, troubleshooting, disassembly, and repair for various levels of maintenance.

1-2. Forms and Records

a. DA Forms and records used for equipment maintenance will be only those prescribed in TM 38-750.

b. Report of errors, omissions, and recommendations for improving this publication by the individual user is encouraged. Reports should be submitted on DA Form 2028 (Recommended Changes to Publications) and forwarded direct to Commanding General, U. S. Army Mobility Equipment Command, ATTN: AMSME-MPP, 4300 Goodfellow Boulevard, St. Louis, Mo. 63120.

Section II. DESCRIPTION AND DATA

1-3. Description

a. The Eutectic MD301 FED, general and inert gas shielded arc welding machine (fig. 1-1 and 1-2), hereafter called the welding machine, is operated from an external power source of either 230 or 460 volts alternating current and by single phase connection. The welding machine can operate as a tungsten inert gas (TIG) welder when water, inert gas (such as argon or helium) and a TIG torch are provided. It can also operate as a shielded metal arc welder.

b. The high frequency and three timer controls which individually control the post-flow of gas and water; preflow of inert gas and spot arc timing are located in a drawer-type frame at the top of the welding machine. The drawer is removable for ease of maintenance.

Figure 1-1. Welding machine right front, three-quarter view with shipping dimensions.

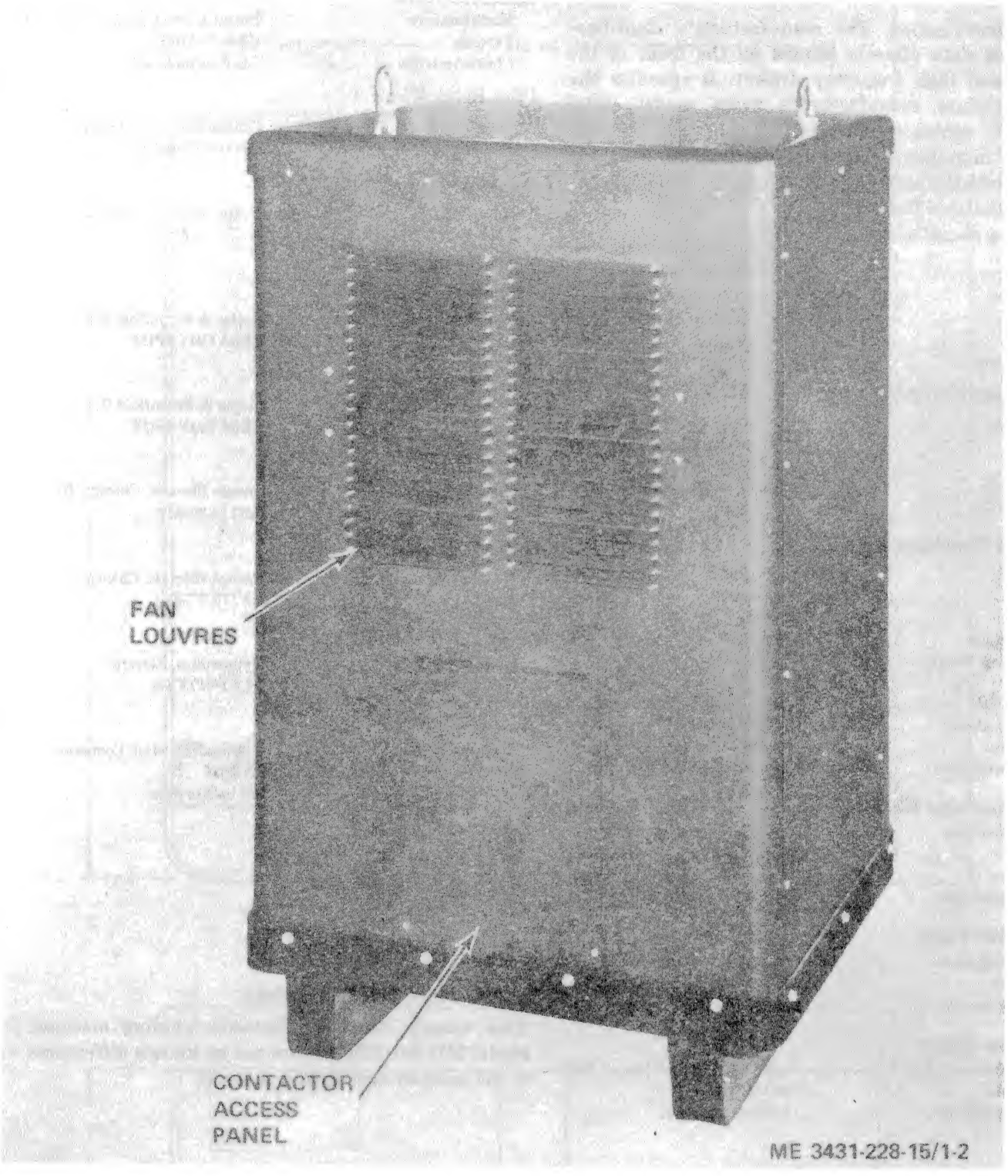


Figure 1-2. Welding machine, left rear, three-quarter view.

1-4. Identification and Tabulated Data

a. Identification. The manufacturer's identification and data plate is located on the front of the timer and high frequency drawer. It specifies the nomenclature, manufacturer's name, model, serial number, contract number, federal stock number, date of manufacture, power input and power output characteristics and ratings and duty cycle percent.

b. Tabulated Data.

Primary (Input power)

Voltage	230 or 460 volts ac
Current	100 amperes at 230 volts 50 amperes at 460 volts
Power	23 kilovolt amperes
Frequency	1 phase, 50 or 60 hertz

Secondary (Output power)

Voltage	32 volts at rated load 80 volts ac without load 72 volts dc without load
Current	5 to 400 amperes max, ac or dc
Duty cycle	60 percent

Overall Dimensions and Weight

Height	41½ inches
Width	24 inches
Depth	22 inches
Net weight	575 pounds
Shipping Weight	650 pounds

Fan Motor

Manufacturer	Universal Electric Co.
Part no.	Mod. CB2J016
Characteristics	230V, 60Hz, 1.11A, 1550 rpm

Main Contactor K8

Manufacturer	Arrow-Hart & Hegeman Elect. Co.
Part no.	ACC-330-U-9
Characteristics	208-240V coil, 50-60 Hz.

Post-Flow Timer

Manufacturer	Potter & Brumfield Div. of AMF
Part no.	CHB-38-31005
Characteristic	1 to 30 seconds adj.

Pre-Flow Timer

Manufacturer	Potter & Brumfield Div. of AMF
Part no.	CHB-38-31005
Characteristics	1 to 30 seconds adj.

Spot Arc Timer

Manufacturer	Potter & Brumfield Div. of AMF
Part no.	CKB-38-31002
Characteristics	1 to 6 seconds adj.

Pilot Relay K1

Manufacturer	Omega Electric, Chicago, Ill.
Part no.	KN115-2C-10KS

Soft Start Delay Relay K2

Manufacturer	Potter & Brumfield Div. of AMF
Part no.	KCP11-2500-2

Soft Start Power Relay K3

Manufacturer	Potter & Brumfield Div. of AMF
Part no.	PR5AY24VSPDT

Soft Start Preset Relay K4

Manufacturer	Potter & Brumfield Div. of AMF
Part no.	PR5AY24VSPDT

Power Relay K5

Manufacturer	Omega Electric, Chicago, Ill.
Part no.	KN110-26-24A

Control Relay K6

Manufacturer	Omega Electric, Chicago, Ill.
Part no.	KN110-2C-24A

Doverload Relay K7

Manufacturer	Heinemann, Electric
Part no.	HCC1-617XXA

Solenoid Valve

Manufacturer	Automatic Switch Company
Part no.	8262C22
Characteristics	1/8 inch orifice

Base Plan

Refer to figure 1-3

Wiring Diagrams

Refer to figures 7-1, 7-2.

1-5. Difference in Models

This manual describes Eutectic welding machine, Model MD 301 FED. There are no known differences in the units covered by this manual.

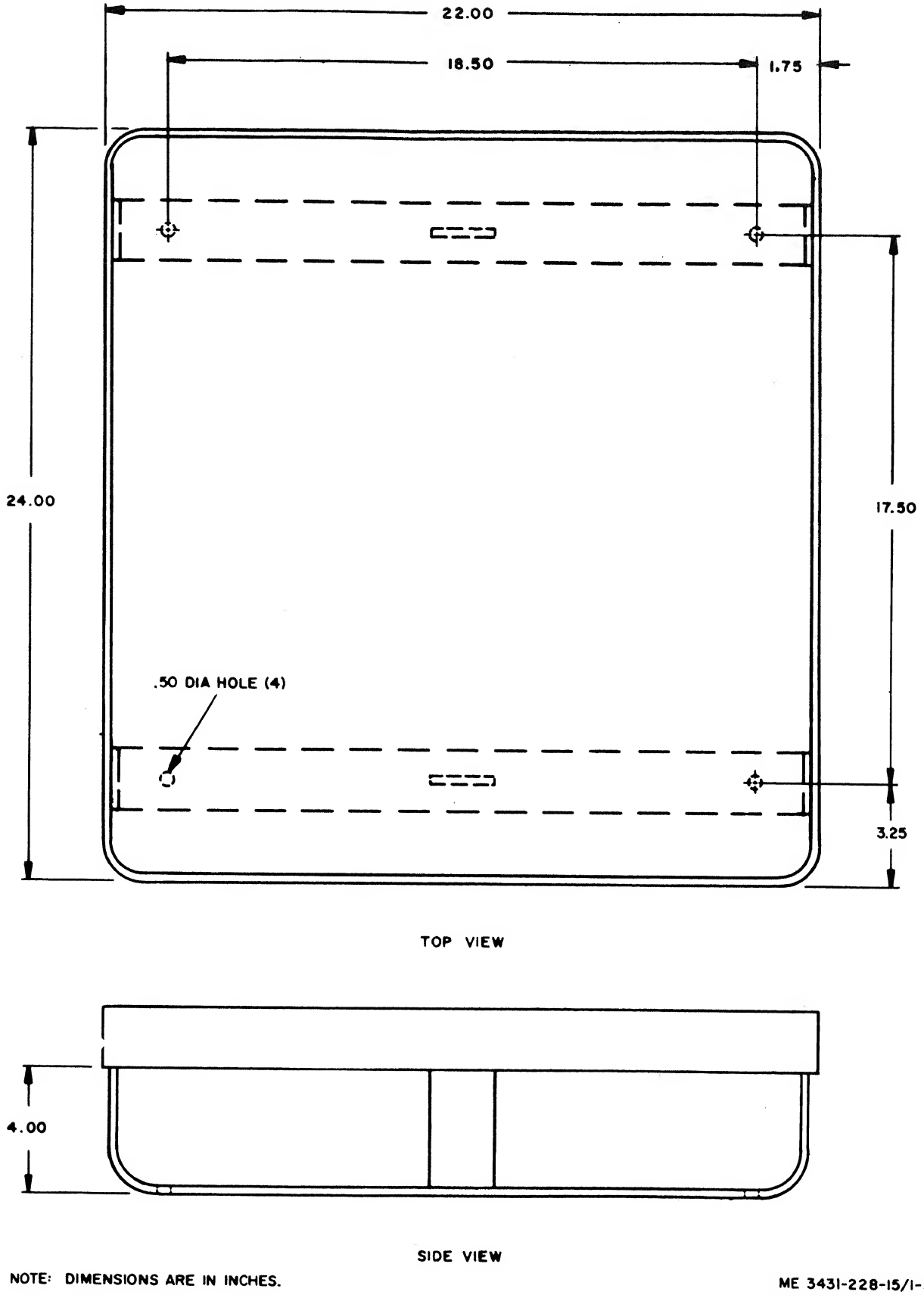


Figure 1-3. Base plan.

CHAPTER 2
INSTALLATION AND OPERATING INSTRUCTIONS

Section I. SERVICE UPON RECEIPT OF MATERIAL

2-1. Unloadinghhe Equipment

a. Remove all fastening devices securing the welding machine to the delivery vehicle.

b. Remove the welding machine with a forklift or other suitable lifting equipment.

Caution: **The welding machine is heavy. Use care when lifting and use equipment with a safe lifting capacity of at least 1000 pounds.**

2-2. Unpacking the Equipment

a. Unpacking.

Caution: **Do not damage the welding machine while removing the wooden box. To protect the welding machine from damage, the machine is wrapped in heavy paper and cardboard and then is crated in a wooden box.**

(1) Remove all metal banding with a suitable tool.

(2) Using a claw hammer, pry bar, nail puller, or any other suitable tool, remove the wooden box.

b. Depreservation. Follow instructions for the inspection and operation of the welding machine as outlined in DA Form 2258.

2-3. Inspecting and Servicing the Equipment

a. Check packing list for missing parts and components.

b. Inspect the equipment for damage parts, dents, scratches, and damaged housing.

c. Check that lifting eyes, panels, hardware and fittings are tight.

d. Check that controls and switches are intact.

e. Perform the daily preventive maintenance services program in paragraph 3-5.

2-4. Installation and Setup Instructions.

a. Location. Place the welding machine near power source, water supply facilities, and gas facilities with at least 36 inch clearance on all sides for proper ventilation and for maintenance accessibility.

b. Ground and Electrode Cable Connections. Refer to figure 2-6 and connect the work cables to the ground terminal stud and electrode terminal stud located behind the front panel of the welding machine. It is recommended that the welding leads be kept as short as possible to prevent high frequency dissipation and erratic operation.

Warning: **Do not operate the welding machine until if has been connected to a suitable ground. An ungrounded machine can cause death by electrocution of personnel coming in contact with it.**

c. External Ground Connections. The welding machine must be grounded prior to operation. Proper grounding of the welding machine will minimize shock hazard and reduce emission of radio interference signals. It has been determined that the best ground is a copperweld ground rod having a minimum diameter of 5/8 inch, driven at least 8 feet into the ground as close as possible to the machine. In an emergency, an ordinary steel or brass pipe of ¾ inch or greater diameter driven to a minimum depth of 8 feet; or a metal plate having a minimum area of 9 square feet buried at least 4 feet under ground, can be used. Rust and electrolytic corrosion will eventually destroy these pipes or metal plates; therefore they should never be used as a permanent installation or for an extended period of time. Treating the soil with a conducting solution (outlined in (1), (2), and (3) below) will accelerate the deterioration of steel and brass but will not adversely affect the copperweld grounding rod. A No. 6 AWG, flexible, stranded copper wire (or larger) is recommended for connecting the ground rod to the work terminal of the welder (fig. 3-1). When the welder is located near an outside wall and the earth beyond this wall is exposed, the ground rod can be placed outside the building. Where a ground lead more than 8 feet in length is required to reach an outside ground rod, it is best to use a ground rod inside the building, immediately adjacent to the welder. If the building has a concrete floor, it will be necessary to make an opening approximately 6 inches in diameter all the way through the concrete floor in order to be able to properly treat the earth around the ground rod. The ground rod should be driven below the level of the concrete surface and a cover provided to avoid accidents.

(1) *Soil treatment for good ground.* The amount of reduction in radiation which a good ground will produce will depend upon the ground resistance. The lower the resistance between the ground rod and the surrounding earth the lower will be the radiated signal. It has been found that if the earth around the ground rod is treated with a conducting solution known as an electrolyte, the signal will be lowered by an appreciable amount.

(2) *Outside ground.* Dig a circular trench around the ground rod. Place in this trench 20 to 30 pounds of rock salt (copper sulphate or magnesium sulphate may also be used). Then flood the trench several times with water, allowing the solution to soak into the ground. The trench can then be filled with earth. Normal rainfall will generally keep the ground moist enough to continually dissolve more salt renewing the electrolyte, thus maintaining a low ground resistance.

(3) *Inside ground.* Fill the 6 inch diameter hole around the ground rod with rock salt (copper sulphate or magnesium sulphate is equally as effective) and flood this a number of times with water until at least 8 or 10 pounds have dissolved and soaked into the earth. Then fill the hole with salt and let it remain in this condition. It will be necessary to flood the hole periodically in order to keep enough electrolyte in the ground circuit; therefore, provide a removal cover instead of pouring concrete around the ground rod.

d. Special Pocedures for High Frequency Suppression. Installation of the high frequency welder, described in this manual, should be made in accordance with the following instructions. The importance of a correct installation cannot be over emphasized since case histories of radio interference due to high frequency stabilized arc welders have shown that, invariably, inadequate installation was at fault.

(1) *Shielding power service lines.* The primary power service leads serving the welder shall be completely enclosed, for a distance of at least fifty (50) feet in any direction from the welder, in solid metallic conduit or in equivalent shielding (copper braid sleeving or lead covered cable is satisfactory). This shielding shall be grounded at the farthest point from the equipment and should make good electrical contact with the casing of the equipment. The ground should be in accordance with the specifications outlined in paragraph 2-4c and as shown in figure 2-1-B. Care should be taken that paint or corrosion at the junction of conduit and of the welder case do not interfere with good electrical contact. There shall be no gap in this shielding run. If the electrical efficiency of the joints between individual conduit sections, outlet boxes and the welder case are questionable, bonding shall be accomplished by soldering a copper strap or wire across the joint as shown in figure 2-1-E.

(2) *Grounding the welding circuit and welder case.* The location of the welder should be chosen with respect to nearness to a suitable ground connection. It is very important that not more than one ground be used in the welding circuit. The welder case, firmly bonded to the power conduit, should be grounded to the work terminal of the welder with a copper cable or braid with rated current carrying capacity equal to or greater than that of the power service wires. The work output terminal should then be connected to a good electrical ground with a No. 6 AWG flexible, stranded copper wire (or larger) which shall not exceed 8 feet in length. (fig. 2-1-B). An indoor ground rod installation may be necessary to comply with the 8 feet maximum ground lead length. The work or work table should not be grounded since the addition of a ground at this point will generally increase the amount of radiation. If, for any reason, it is impossible to avoid a ground at the work or work table, then put the ground rod near the work table, making this the only ground in the system. (fig. 2-1-C). The ground connection to the enclosure of the welder can still be connected to the work terminal of the welder. However, the welder case will secure its ground through the ground lead of the welding circuit, to the work table, and thence to the ground rod. The welder case should not be grounded by means of a third conductor in the primary cable. The welder should not be operated unless the case is grounded in accordance with the foregoing. The metal enclosure of the welder, if properly grounded as outlined above, will practically eliminate any radiation from inside the machine. However, all service and access doors must be closed and fastened during operation. Any opening in the metal case of the welder will allow some radiation to escape.

(3) *Shielding electrical conductors in close proximity to welding area.* The most serious source of interference is reradiation from wires that are located near the welding area. Any ungrounded electrical conductor in the strong "directly radiated" field, produced by the welding leads, serves as a pick-up device and may conduct the interference for some distance and reradiate strongly at another location. For purposes of simplification and standardization, the space all around the weld zone, at a distance of 50 feet in all directions, is referred to as the high field intensity (H.F.I.) Zone (fig. 2-1-F). To minimize radiation of this type, all wiring in the H.F.I. Zone shall be in rigid metallic conduit, lead covered cable, copper braid or material of equivalent shielding efficiency. Ordinary flexible helically wrapped metallic conduit, commonly referred to as "B.X." is

not satisfactory for shielding, and should not be used. The shield on all wiring should be grounded at intervals of 50 feet and good electrical bonding between sections shall be maintained. (fig. 2-1-E & F). This shielding requirement applies to all wiring, including telephone, intercommunication, signal and control, and incidental service. The foregoing procedures shall apply even if:

(a) The welding area is not a fixed location.

(b) There are exposed wires off the premises within 50 feet of the welding area.

(4) *Placement of welding leads.* Direct radiation from the welding leads, although very pronounced, decreases rapidly within distance from the leads. The operator can minimize interference radiating from the welding leads by adhering to the following rules (fig. 2-1-G):

(a) Keep the welding leads as short as possible.

(b) Keep the electrode lead and ground or work lead as close together as possible (¾ inch to 1 inch apart) and on the floor or placed on a suitable board.

(5) *Adjustment of spark gap.* Spark gap settings shall be maintained at the minimum separation consistent with satisfactory welding results. The recommended maximum gap setting is 0.008 inches. The wider the spark gap setting, the greater is the power which is radiated.

(6) *Installation in metal buildings.* It is frequently thought that operation of high frequency stabilized arc welding equipment in metallic buildings will completely eliminate troublesome radiation. This, however, is a false assumption. A metallic building structure, if properly grounded, may serve to reduce radiation from the weld zone but will have no effect on conducted interference and reradiation. As a result, all installation requirements outlined above must be complied with. Additionally, the metal building must be bonded to several ground rods placed around the periphery of the building. For best results the earth around these ground rods must be treated (para 2-4.c.(2).

(7) *Check list of high frequency stabilized arc welding equipment installation.*

(a) Has the equipment been located so that ground leads can be kept short (8 feet or less)?

(b) Are the power leads serving the unit in rigid metallic conduit?

(c) If rigid metallic conduit is not used, is equivalent copper braid sleeving, or lead covered cable used?

Note. Flexible helically wrapped metallic conduit (BX) is not suitable.

(d) Is there good electrical contact between power conduit and welder case?

(e) Is there good electrical contact between conduit and switch on service boxes?

(f) Do the conduit couplings make good electrical contact?

Note. If in doubt on (d), (e) and (f) use bonding.

(g) Is the conduit system grounded at a point at least 50 feet from the welder?

(h) Have the unshielded power and light wires in the H.F.I. Zone been placed in grounded shields or been relocated outside the zone?

(i) Is the conduit run complete (without any gap) in the H.F.I. Zone?

(j) Have all large metallic objects and any long guy or supporting wires in the H.F.I. Zone been grounded?

(k) Is the welder case connected to the work terminal of the secondary?

(l) Is the wire used for this connection of sufficient size?

(m) Is the work terminal connected to a good electrical ground?

(n) Is this cable as short as possible?

(o) Are the spark gaps set at 0.008 inches?

(p) Are all service or access doors closed?

(q) Are the welding leads as short as possible? (Do not exceed 25 feet in length).

(r) Are the welding leads on the floor or placed on a suitable board?

(s) Are the welding leads approximately ¾ to 1 inch apart?

(t) Have you checked so that no external power or telephone lines off the premises are within this zone?

(u) Are the connections to the ground clean and tight?

(v) If operated within a metal building, is the building properly grounded?

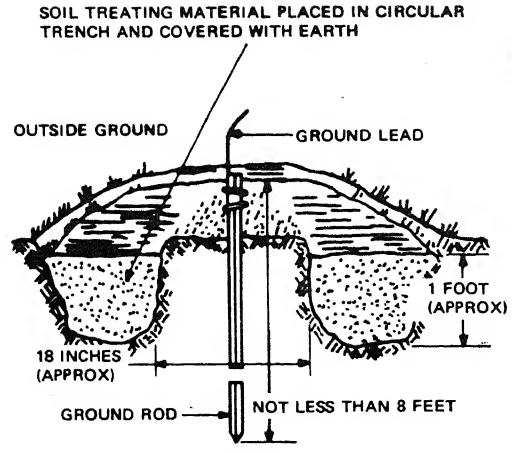
Note. When a water recirculating pump is used, the incoming water hose and torch water hose should not be connected to the water solenoid valve on the side of the welder. Instead, the torch water hose should connect directly to the recirculator. The cooling water will then circulate continuously and the recirculating pump will not have to work against a closed valve when the operator is not welding.

e. Water Connections. Connect water fittings and pipes to the lower fittings on the side panel of the machine. (fig. 2-2). Refer to paragraph 4-3 for connections using a water strainer.

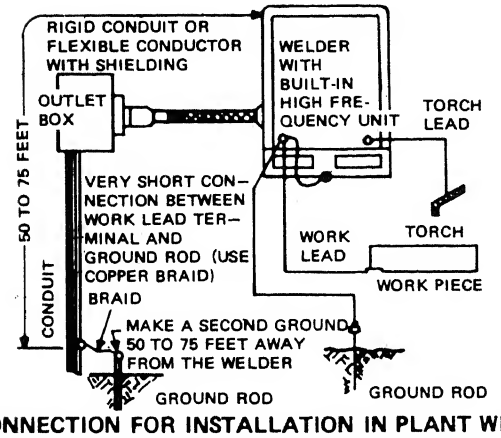
***Warning:* Use a plastic or rubber hose between the connector assembly and water drain.**

f. Gas Connections. Connect gas fittings and pipes to the upper fittings on side panel of the machine. (fig. 2-2).

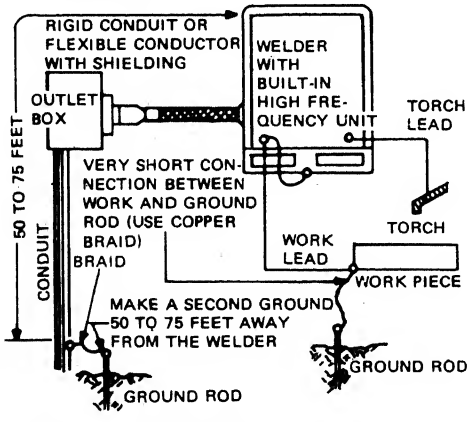
g. Power Connection. The welding machine can operate from either 230 vac or 460 vac by correctly positioning jumpers on a terminal block. (fig. 2-3). Connect power to L1 and L2 through a fuse box



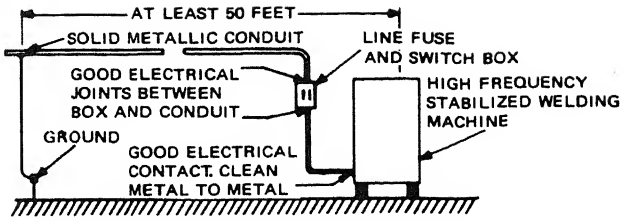
A. GROUND ROD INSTALLATION.



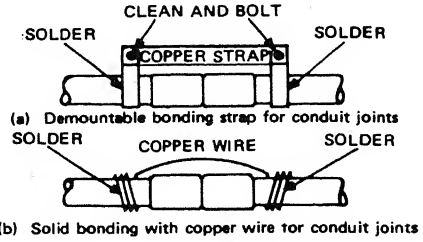
B. CONNECTION FOR INSTALLATION IN PLANT WITH WIRING IN CONDUIT AND NO GROUND CONNECTION TO WORK (PREFERRED)



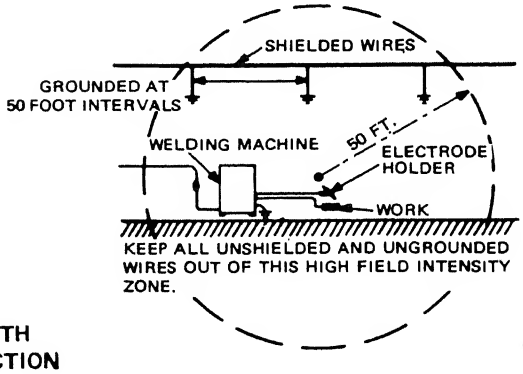
C. CONNECTION FOR INSTALLATION IN PLANT WITH WIRING IN CONDUIT AND GROUND CONNECTION TO WORK (ALTERNATE).



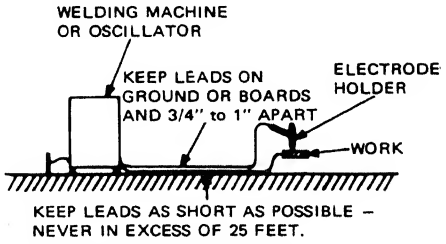
D. POWER SERVICE INSTALLATION.



E. RECOMMENDED METHODS FOR ELECTRICAL BONDING.



F. GENERAL REQUIREMENTS TO MINIMIZE RERADIATION PICK-UP.



G. GENERAL RULES FOR WELDING LEADS.

ME 3431-228-15/2-1

Figure 2-1. Grounding methods.

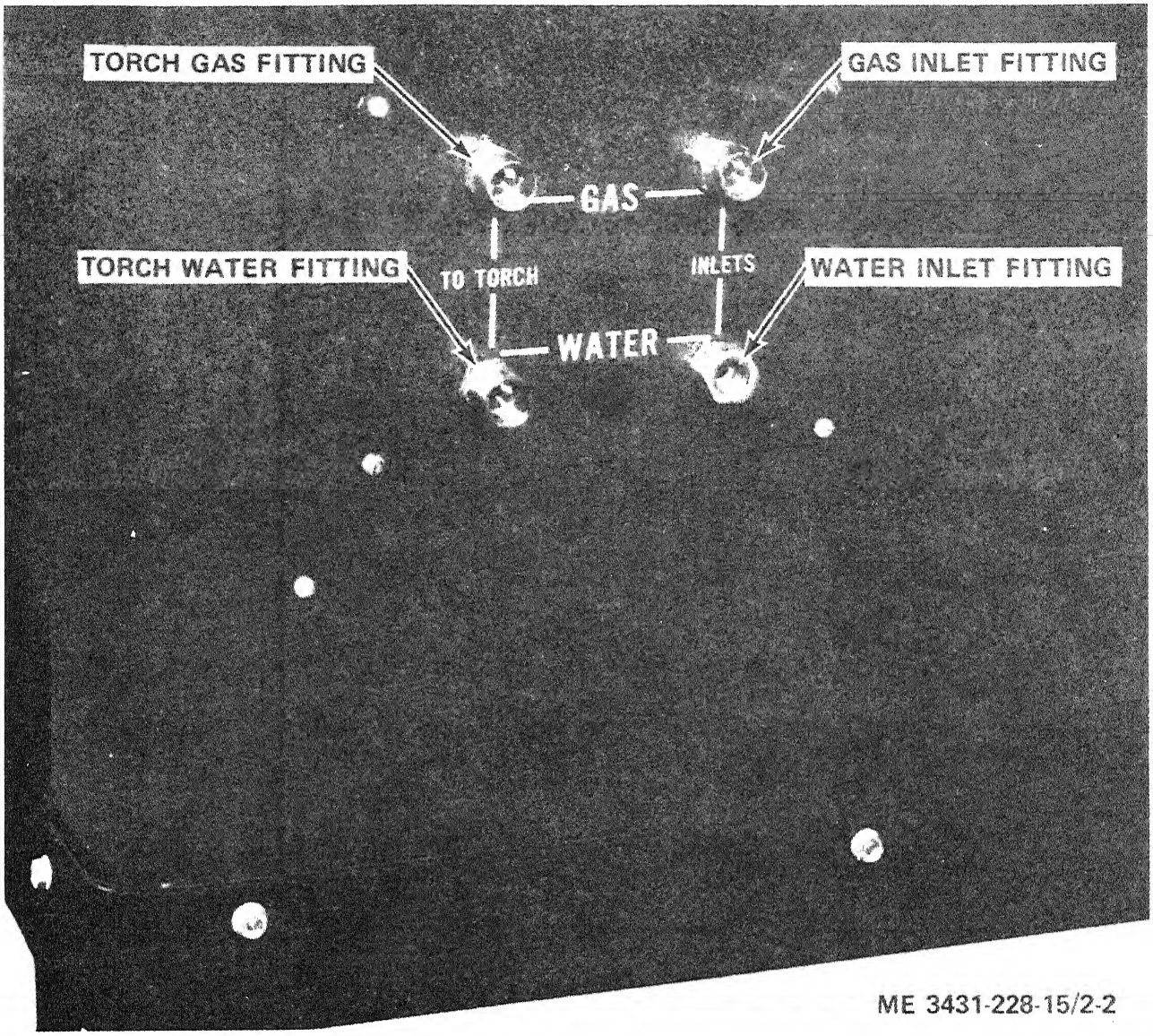
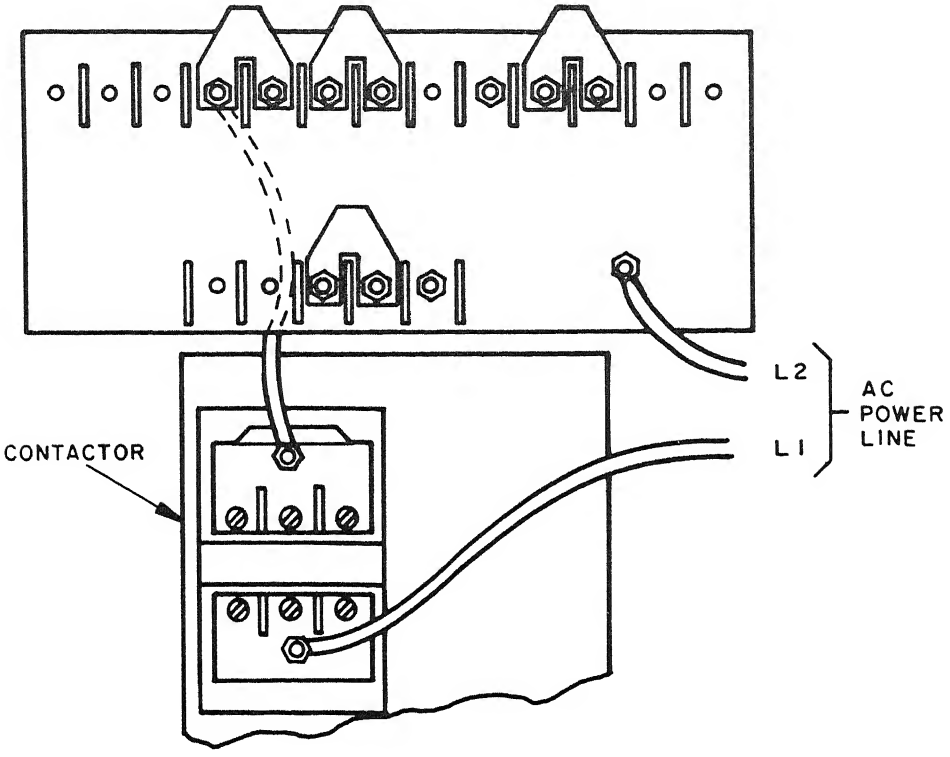
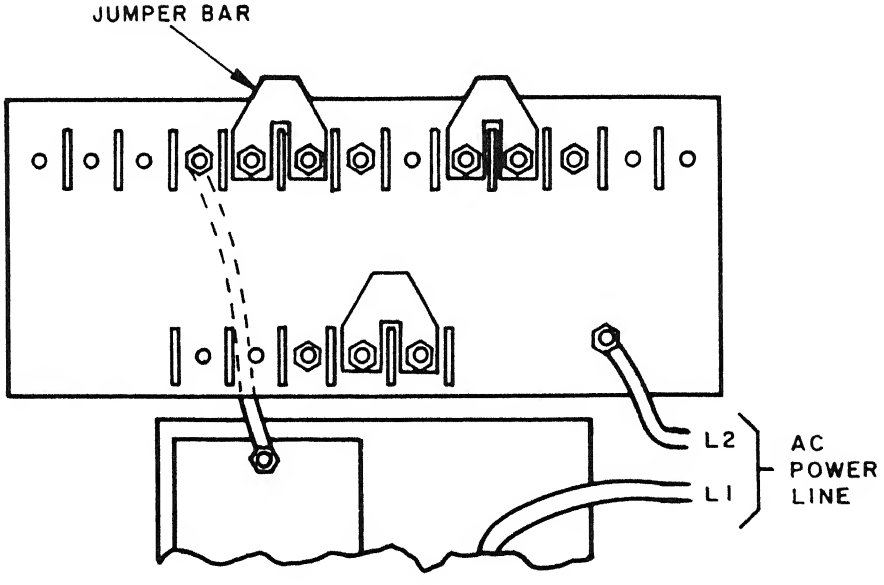


Figure 2-2. Gas and Water Connections.



A. FOR 230 VAC LINE



B. FOR 460 VAC LINE

ME 3431-228-15/2-3

Figure 2-3. Voltage change bars for 230 or 460 volt input.

with a disconnect switch.

(1) Check voltage source. Remove the two screws at the bottom of the contactor access panel on the rear of the machine. Open the hinged panel.

(2) Check that the jumpers (voltage-change bus bars) are located properly for the available voltage. (fig. 2-3). (A copy of figure 2-3 is on the back of the access panel door).

(3) Connect the welding machine to ac power. Use no. 3 AWG wire for 230-volt input and no. 6 AWG wire for 460-volt input when wires are 25 feet long or shorter. Provide a 150 ampere fuse for 230-volt input and an 80 ampere fuse for 460-volt input.

Note. The machine will operate from a single phase power line or from any one phase of a three-phase power line. For use on three-phase power lines, choose any two of the three hot wires plus a grounding wire for connection to the welding machine. Using conduit, bring the two primary power leads and the ground wire through the cable entrance hole directly below the primary panel of the welding machine. Connect the two primary power leads to the line terminals on contactor and primary panel. Attach the grounding wire to the grounding screw located below the contactor inside the rear door.

Section II. MOVEMENT TO A NEW WORKSITE

2-5. Dismantling for Movement

a. Reverse the sequence of the steps taken in paragraph 2-4, disconnecting cables, ground connections, and hoses and/or piping from gas and water connections.

b. Cover the water and gas connection fittings if the welding machine is to be moved other than a short distance. Load the machine on the carrier using a suitable lifting device. If the machine is to be moved within a building, it can be moved with a fork-lift, or on its skids.

2-6. Reinstallation after Movement

Proceed in accordance with the instructions given in paragraph 2-4. The procedure is identical to that of installation.

Section III. CONTROLS AND INSTRUMENTS

2-7. General

This section describes the various controls and instruments and provides the operator sufficient information to insure proper operation of Model MD301 FED Inert Gas Shielded Arc Welding Machine.

2-8. Controls and Instruments

a. Figure 2-4 illustrates the front panel of the machine, which contains all operator's controls and instruments. Figure 2-5 illustrates the controls in the timer drawer.

b. The purpose of the controls and instruments are as follows:

(1) *POWER switch.* Two-position momentary switch turns power ON or OFF.

(2) *POWER indicator light.* Located beside the POWER switch, this light glows red when the POWER switch is ON and power is connected.

(3) *GAS-WATER switch.* This two-position switch turns the gas and water ON or OFF. It is used in the ON position during TIG welding, and must be OFF for metallic arc welding.

(4) *GAS-WATER* indicator light. This light glows red when the GAS-WATER switch is in the ON position and goes out when timer M1 times out.

(5) *HIGH FREQUENCY switch.* This two-position switch applies power to a high-frequency transformer when in the ON position, for use in high frequency welding.

(6) *HIGH FREQUENCY indicator light.* This light glows red when the HIGH FREQUENCY switch is ON. The light is located beside the switch. It goes out after the arc is started if HIGH FREQUENCY dropout switch is in START ONLY position.

(7) *HIGH FREQUENCY START control.* This control is an intensity selector used to dampen the

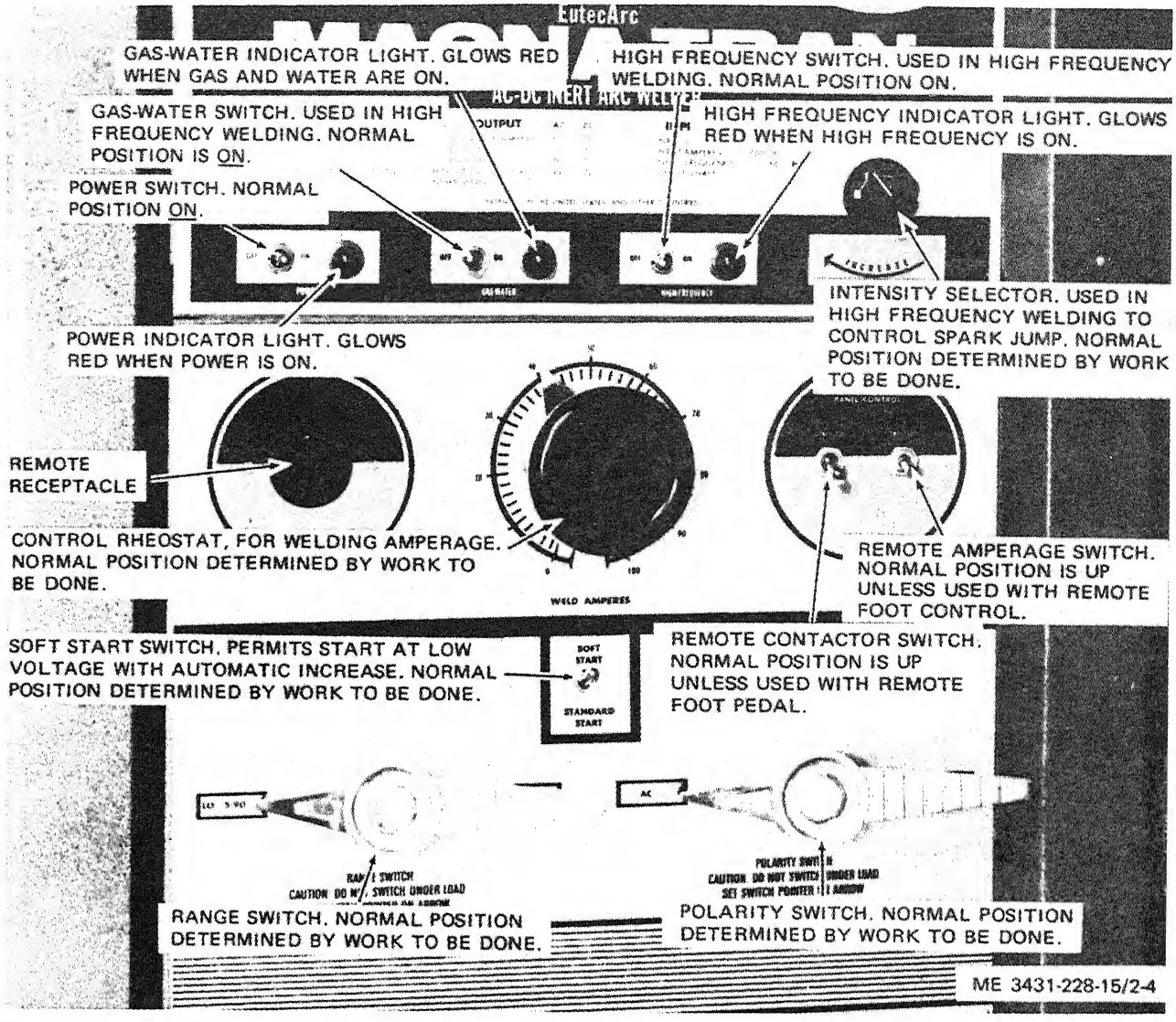


Figure 2-4. Controls and instruments, front panel.

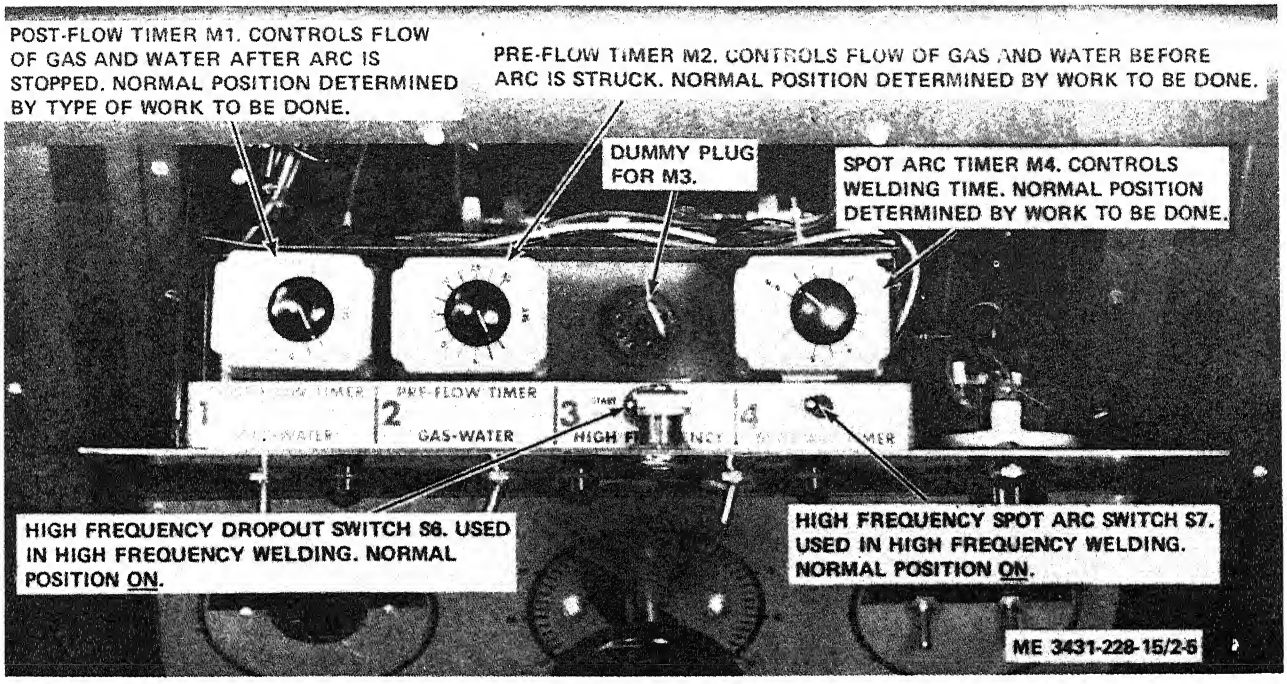


Figure 2-5. Timer drawer, controls.

high frequency generated in high frequency welding. Normal position depends on work being done.

(8) *REMOTE RECEPTACLE.* This receptacle provides connection for a remote foot control, which can control the welder contactor and amperage functions.

(9) *WELD AMPERES control rheostat.* Controls the amperage available for welding. Normal position depends on work being welded. Calibrated range is 0 to 100.

(10) *CONTACTOR switch.* This two-position switch permits control of the power contactor by the remote switch, or it permits panel control of the power contactor. Place the switch in the PANEL CONTROL position when remote foot control is not used.

(11) *AMPERAGE switch.* This two-position switch permits the remote foot control to vary the welding current up to the maximum value set on the WELD AMPERES control. Switch is in the PANEL CONTROL position when the remote foot control is not used.

(12) *SOFT START switch.* This two-position switch permits start at low current with automatic increase.

(13) *RANGE SWITCH.* This three-position rotary switch selects one of three current ranges and has an open position between each range position. Normal position depends on work being done. Ranges are: LO 5-90, MED 30-235, HI 150-400.

(14) *POLARITY SWITCH.* This three-position switch selects the polarity of the voltage at the electrode. Switch selects AC, DC STR., or DC REV. This switch also has an open position between each marked position. Position depends on type of work being done.

(15) *SPOT ARC TIMER switch.* This two-position switch, located inside the high frequency drawer, (fig. 2-5) switches the spot arc timer on or off. In the OFF position, the timer is disabled.

(16) *HIGH FREQUENCY dropout switch.* This two-position switch, located inside the high frequency drawer, (fig. 2-5) permits choosing the method of starting the high frequency circuit. In the START ONLY position, operation is controlled by the pilot relay. In the CONTINUOUS position, neither the pilot relay control nor the high frequency timer will affect the high frequency dropout.

(17) *PRE-FLOW TIMER control.* This variable control is on top of the timer (fig. 2-5) and controls the length of time that gas and water flows before the arc can be struck. Time is variable from 1 to 30 seconds.

(18) *POST-FLOW TIMER control.* This control, located on top of the timer (fig. 2-5) varies the length of time that shielding gas and water will flow after the arc is broken. Time is variable from 1 to 30 seconds.

(19) *SPOT ARC TIMER control.* This control, located on top of the timer (fig. 2-5), varies the time that the timer allows the arc to be on. It is functional only when the SPOT ARC switch is not in the OFF position (para 3-16b).

Section IV. OPERATION UNDER USUAL CONDITIONS

2-9. General

This section contains step-by-step procedures for various types of operation. Each type of operation, including starting and stopping the welding machine, is described. Since each job may present a different problem, the operator may have to vary given procedures to fit the individual job.

2-10. Starting Procedures

a. Preparation for Starting.

(1) Perform the daily preventive maintenance services program described in paragraph 3-5.

(2) Clean area on item to be welded to insure a good connection.

(3) Connect the cables to the welder electrode and ground terminals (fig. 2-6) and connect the ground clamp of the ground cable to the work table or item to be welded.

Caution: **Do not operate the current range switch or the AC/DC selector and polarity switch under load. Arcing caused by opening the switch carrying high current will severely burn the contact surface of these switches. This burning of the contact surfaces will decrease the maximum current carrying capacity of the switches and possibly cause the switches to become inoperative.**

b. Starting. Refer to figure 2-7 and start the welding machine.

Note. If a sustained overload or power failure occurs, the welding machine shuts off. The POWER switch must be placed in ON position again to restore to standby condition.

2-11. Stopping Procedures

a. Refer to figure 2-8 and stop the welding machine.

b. Perform the after operation services (table 3-1).

2-12. Setup for Operation

a. General. The welding machine is designed for use in coated electrode metallic arc welding and in inert gas shielded tungsten arc welding. The machine has a RANGE SWITCH which provides optimum amperage for light and heavy work. The WELD AMPERES control on the front panel adjusts the output within each range. A foot-operated remote control can also adjust the output current within each range. For choice of the welding output current preferred in each welding job the machine has a POLARITY SWITCH. The normal position of this switch is determined by the work being done.

b. Timer Control System. The timer control system of this welding machine provides any combination of four different timer functions, although this specific machine includes only three of the timers. The optional HIGH FREQUENCY dropout timer is not provided. Instantaneous high frequency dropout is provided as standard with this welding machine even though no timer is used. The white dummy plug must be in the high frequency timer socket and the high frequency dropout switch set on START-ONLY in order to obtain this function. The plug-in timers govern the timing of the following functions: post-flow of gas and water; pre-flow of inert gas; and spot arc timing. The timers are in a drawer at the top of the welding machine, along with the high frequency section. The drawer opens to obtain access to the timer controls for adjustment or maintenance by unlocking the key lock and tilting the front of the drawer. An interlock switch opens the main contactor K8, removing power to main transformer T1 when the drawer is opened. The entire drawer section can be unplugged and removed for servicing. The drawer is secured with six screws behind the drawer panel.

c. Setting Timers. Before starting a new welding procedure, the operator must decide which control timers are to be used. A dummy plug must be in each timer receptacle if the timer is not installed. If dummy plugs are removed to insert a timer, save plugs for future use. The PRE-FLOW TIMER and

POST-FLOW TIMER are normally 30 second timers. The SPOT ARC TIMER is normally a 6 second timer. Set the timers according to the following procedures.

(1) Unlock and open the drawer.

(2) Adjust the applicable timers by setting the dial to the desired seconds of delay time. Refer to torch manual for settings.

(3) For timers not being used, set controls as follows:

(a) If PRE-FLOW TIMER is not to be used, set dial to 0 (zero).

(b) If POST-FLOW TIMER is not to be used, set dial to 0 (zero).

(c) Set HIGH FREQUENCY dropout switch to ON CONTINUOUS, when dropout of the high frequency is not desired. Set to START ONLY when high frequency dropout is desired after start of arc. This function occurs instantly after the arc starts due to operation of a relay circuit (K1).

(d) If SPOT ARC TIMER is not to be used, set SPOT ARC TIMER switch to OFF.

(4) Close drawer tightly.

(5) Lock drawer.

Note. The drawer operates an interlock switch which completes the entire welding circuit. The welding machine will not operate with the drawer open.

d. Remote Control. To have both amperage control and start/stop at the operator's station, a remote foot control plugs into the REMOTE RECEPTACLE. This remote foot control contains both a switch for activation of the start/stop contactor and a rheostat for adjustment of the welding amperage. Hence, both the AMPERAGE switch and the CONTACTOR switch must be in the REMOTE RECEPTACLE positions (down) when the remote foot control is in use. For remote control, proceed as follows.

(1) Connect remote foot control to REMOTE RECEPTACLE.

(2) Place CONTACTOR switch in REMOTE RECEPTACLE position.

(3) Place AMPERAGE switch in REMOTE RECEPTACLE position.

e. Switch Adjustments.

(1) Set POLARITY SWITCH to AC, DC STR., or DC REV. according to the welding requirements.

(2) Set RANGE SWITCH to LO 5-90, MED 30-235 or HI 150-400 whichever allows maximum adjustment above and below the amperage needed.

(3) Set WELD AMPERES control to the approximate percentage of amperage selected with the RANGE SWITCH.

Note. The numbers on the scale do not read directly in amperes of welding current. The proper scale setting is best determined by working on a sample piece before starting the welding job.

(4) Adjust HIGH FREQUENCY START control to increase or decrease the intensity of the spark jump.

Note. The distance the spark jumps will increase as the tungsten becomes heated and will vary also with the cable length, base metal type, etc.

(5) Set CONTACTOR switch for PANEL CONTROL or REMOTE RECEPTACLE control as desired to affect start/stop control of welding power output.

Note. When set in the PANEL CONTROL position it allows the POWER switch to directly control the ON and OFF of welding power. When set in the REMOTE RECEPTACLE position it passes the start and stop operation to the remote foot control plugged into the REMOTE RECEPTACLE.

(6) Set AMPERAGE switch to PANEL CONTROL or REMOTE RECEPTACLE.

Note. When set in the PANEL CONTROL position, welding current may be adjusted at the welding machine with WELD AMPERES control; when set in the REMOTE RECEPTACLE position, the welding current is controlled by the remote foot control plugged into the REMOTE RECEPTACLE.

(7) Limit the maximum current available when several identical pieces are to be welded and the remote foot control is being used.

(a) Depress remote foot control to its maximum position and hold.

(b) Set WELD AMPERES control to maximum current needed.

(c) Release remote foot control.

(8) To repeat exact starts, depress remote foot control to maximum position for each start.

(9) Set SOFT START/STANDARD START switch to select a 2 second interval of approximately half of the normal current (SOFT START) or full current start (STANDARD START).

Note. Normally the switch is set to STANDARD START when the machine is used in the low range (LO 5-90) or when the remote foot control is used. The switch is normally set to SOFT START when the machine is used in the medium (MED 30-235) or high (HI 150-400) range, or when tungsten inclusion is to be avoided.

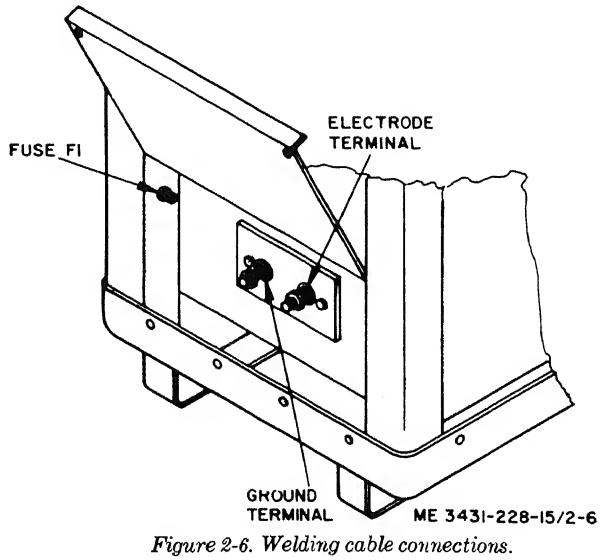


Figure 2-6. Welding cable connections.

ME 3431-228-15/2-7

Figure 2-7. Starting the welding machine.

ME 3431-228-15/2-8

Figure 2-8. Stopping the welding machine.

2-13. Operating Procedures

a. Connect cables to the electrode and ground terminals (fig. 2-6) on the welding machine. (para 2-4).

b. If using inert gas welding, refer to table 2-1 and select proper electrode.

Note. Refer to TM 9-237 for metallic arc welding theory and application.

c. Use a sample piece of metal, like the metal to be welded and adjust the welding amperage to produce the correct arc necessary for the welding to be done.

Warning: **Do not come in contact with the electrode while the welding machine is operating. The high voltage generated by the machine can cause death by electrocution.**

Note. The welding machine is equipped with a remote receptacle and can be operated by remote control. When using the remote control, the contactor and amperage switches must be in the remote position. When the remote amperage control is used, the maximum current available will be limited by the setting of the panel rheostat. If full range is necessary, the weld amperes control must be set wide open (maximum clockwise).

Table 2-1. Typical Electrode Size for Applied Current

Tungsten electrode size (diameter)	Welding current (amperes)
0.040 in.	10 - 60
1/16	50 - 100
3/32	100 - 160
1/8	150 - 210
5/32	200 - 275
3/16	250 - 350
1/4	325 - 475

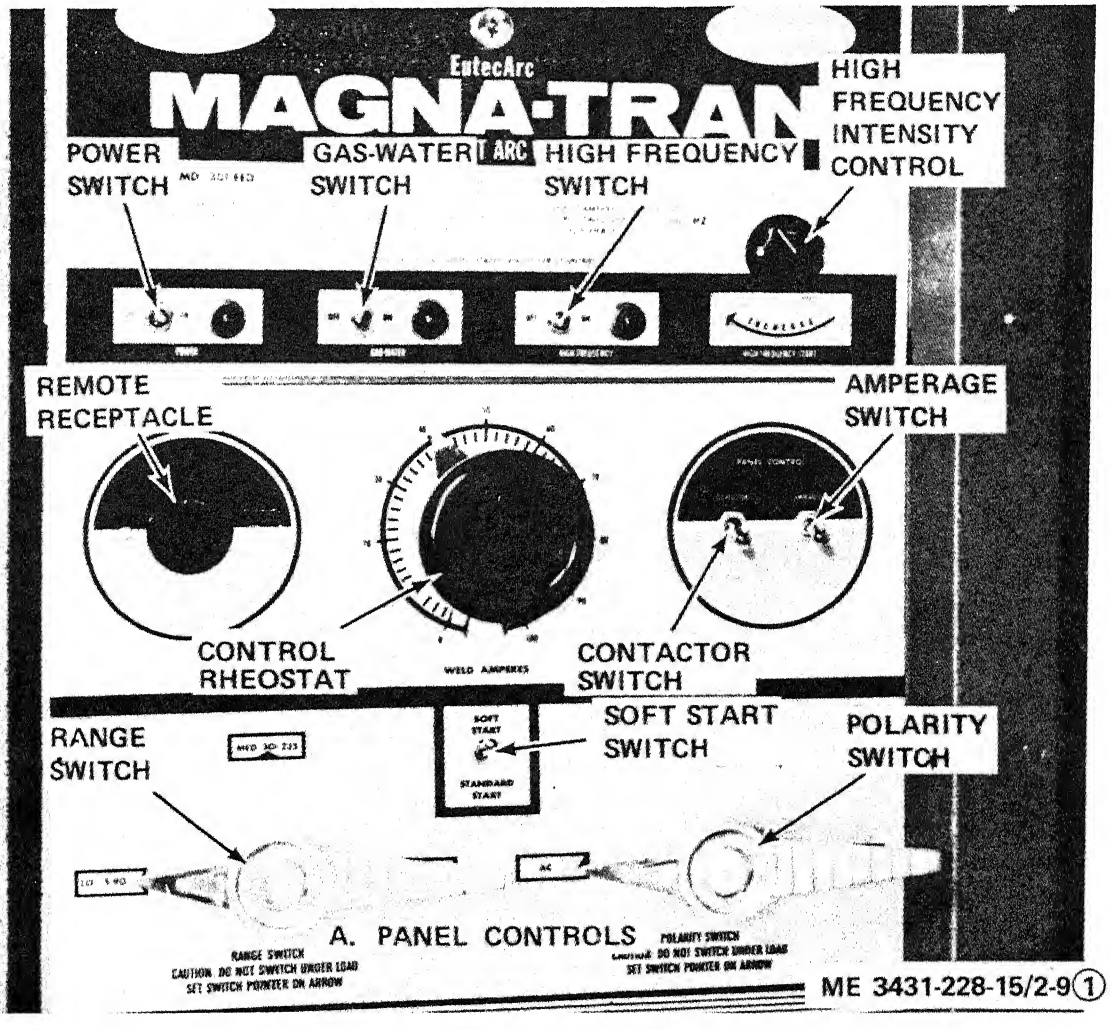


Figure 2-9. Welding machine operation.

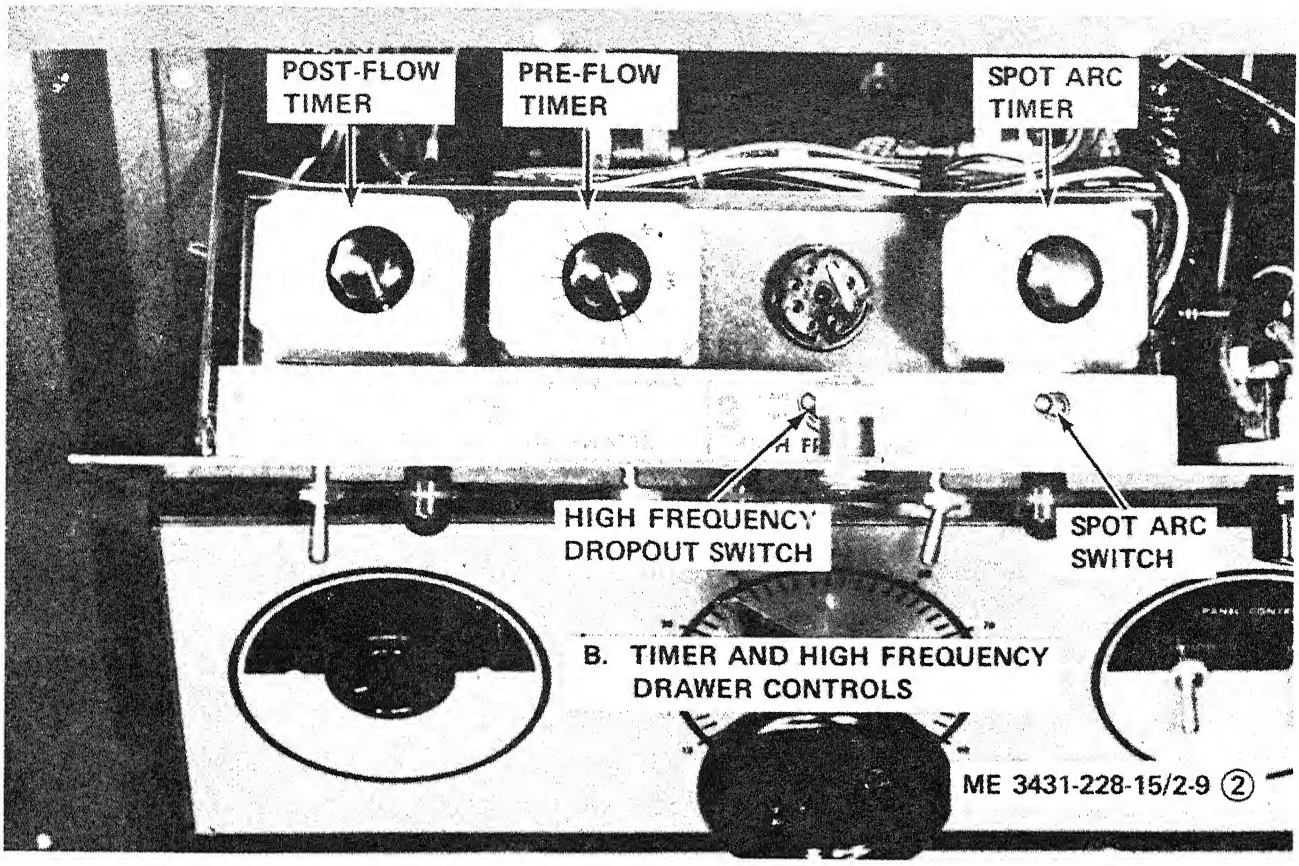


Figure 2-9. ② Welding machine operation.

METALLIC ARC WELDING

STEP 1. SET ALL TIMERS TO ZERO, PLACE SPOT ARC SWITCH IN OFF POSITION, PLACE HIGH FREQUENCY DROPOUT SWITCH IN ON CONTINUOUSLY POSITION.

STEP 2. PLACE CONTACTOR AND AMPERAGE SWITCHES IN PANEL CONTROL POSITION UNLESS REMOTE CONTROL IS DESIRED.

STEP 3. PLACE SOFT START SWITCH IN THE STANDARD START POSITION.

STEP 4. PLACE GAS-WATER SWITCH IN OFF POSITION.

STEP 5. PLACE HIGH FREQUENCY SWITCH IN ON POSITION IF DESIRED.

STEP 6. DETERMINE WELDING RANGE BY SIZE OF WORK TO BE DONE AND SELECT PROPER ELECTRODE SIZE AND SET RANGE SWITCH TO PROPER POSITION.

STEP 7. SET POLARITY SWITCH IN ACCORDANCE WITH TYPE OF WELDING TO BE DONE AND TYPE OF ELECTRODE USED.

STEP 8. START THE WELDER, COMMENCE WELDING AND RE-ADJUST THE CONTROLS AS NECESSARY UNTIL PROPER WELDING OPERATION IS OBTAINED.

ME 3431-228-15/2-9 ③

TUNGSTEN INERT GAS WELDING

STEP 1. TURN ON SOURCES OF GAS AND WATER. GAS FLOW SHOULD BE SET AS REQUIRED.

STEP 2. PLACE CONTACTOR SWITCH AND AMPERAGE SWITCH IN REMOTE RECEPTACLE POSITION. IF REMOTE CONTROL IS DESIRED – CONNECT REMOTE CONTROL TO REMOTE RECEPTACLE.

STEP 3. PLACE GAS-WATER SWITCH IN ON POSITION.

STEP 4. PLACE HIGH FREQUENCY SWITCH IN ON POSITION.

STEP 5. SET POST FLOW TIMER TO DESIRED POSITION (1 TO 30 SECONDS).

STEP 6. SET PRE FLOW TIMER TO DESIRED POSITION (1 TO 30 SECONDS).

STEP 7. PLACE HIGH FREQUENCY DROP OUT SWITCH IN START ONLY POSITION FOR DC WELDING OR TO ON-CONTINUOUS FOR AC WELDING.

STEP 8. DETERMINE WELDING RANGE BY SIZE OF WORK TO BE DONE AND SET RANGE SWITCH TO PROPER POSITION, SELECT PROPER ELECTRODE, AND SET POLARITY SWITCH AS DESIRED.

NOTE: FOR DC TIG WELDING, 1% OR 2% THORIATED TUNGSTEN ELECTRODES ARE NORMALLY USED. FOR AC WELDING, PURE OR ZIRCONIUM TUNGSTEN ELECTRODES ARE NORMALLY USED.

STEP 9. ADJUST CONTROL RHEOSTAT FOR PROPER WELDING CURRENT.

STEP 10. IF SOFT START IS DESIRED, SET SOFT START SWITCH TO SOFT START POSITION.

STEP 11. SET HIGH FREQUENCY INTENSITY CONTROL TO MIDPOSITION OF RANGE. RE-ADJUST AS NECESSARY.

STEP 12. START THE WELDER. COMMENCE WELDING AND RE-ADJUST CONTROLS AS NECESSARY UNTIL PROPER WELDING OPERATION IS OBTAINED.

SPOT ARC WELDING

PROCEED AS FOR TUNGSTEN INERT GAS EXCEPT PLACE SPOT ARC SWITCH IN THE ON POSITION AND SET SPOT ARC TIMER FOR THE DESIRED ARC TIME (0 TO 6 SECONDS). ALSO ADJUST HIGH FREQUENCY INTENSITY CONTROL AS DESIRED FOR THE JOB BEING DONE.

Section V. OPERATION UNDER UNUSUAL CONDITIONS

2-14. Operation in Extreme Cold, Below 0 °F

a. Check the water pipes and lines, verifying that they are not frozen.

b. If frozen, disconnect the water system from the welding machine and use the welding machine for metallic arc welding.

2-15. Operation in Extreme Heat

a. Check operation of the fan motor. Inspect it frequently.

b. Check that the welding machine is well ventilated.

2-16. Operation in Dusty or Sandy Areas

a. Clean dust and sand from welding machine as often as necessary.

b. Protect machine from blowing dust and sand by erecting a protective panel or shelter, or taking any other reasonable measure.

c. Keep the welding machine covered when not in use.

2-17. Operation Under Rainy or Humid Conditions

a. Keep rain from the welding machine using as much protection as possible.

b. Keep the welding machine covered when not in use.

c. Do not allow water to come in contact with the high frequency and timer drawer. If it does, remove the drawer and dry thoroughly before reinstalling it in the machine.

Warning: **Be extremely careful when the welding machine or surrounding area is damp or wet. Contact with a wet or damp unit can cause a serious electrical shock or death.**

2-18. Operation in Salt Water Areas

a. Keep the welding machine protected as much as possible but do not block ventilation.

b. Check all connections, terminals, and fittings for corrosion.

c. Keep welding machine covered when not in use.

2-19. Operation in Snow

a. Keep snow off and out of the machine.

b. Shield the machine from blowing snow by erecting a protective panel or shelter, or taking any other reasonable measure.

c. Refer to paragraph 2-14 for cold weather conditions.

2-20. Operation in Mud

a. Check carefully that the surrounding area is dry.

b. Keep mud out of the machine.

c. Check that the unit is dry.

Warning: **A wet or damp unit can cause a serious electrical shock or death.**

2-21. Operation at High Altitude or Below Sea Level

a. Take normal precautions for cleanliness and keeping water, dust, mud, or snow, out of the welding machine.

b. There is no substantial difference in the operation of the welding machine at different altitudes.

CHAPTER 3
OPERATOR AND ORGANIZATIONAL MAINTENANCE INSTRUCTIONS

Section I. OPERATOR'S AND ORGANIZATIONAL MAINTENANCE REPAIR PARTS, TOOLS, AND EQUIPMENT

3-1. Special Tools and Equipment

The operator and organizational maintenance personnel require no special tools or equipment for the maintenance of the welding machine.

3-2. Tools and Equipment

Basic issue tools and repair parts issued with or authorized for the welding machine are listed in the Basic Issue Item List, Appendix B, of this manual.

3-3. Organizational Maintenance Repair Parts

Organizational maintenance repair parts are listed and illustrated in TM 5-3431-228-20P.

Section II. PREVENTIVE MAINTENANCE CHECKS AND SERVICES

3-4. General

To insure that the welding machine is ready for operation at all times, it must be inspected systematically to discover and correct defects before they result in serious damage and failure. The necessary preventive maintenance checks and services are listed and described in paragraphs 3-5 and 3-6. The item numbers indicate the sequence of minimum inspection requirements. Defects discovered during operation of the unit shall be noted for future correction, to be made as soon as operation has ceased. Stop operation immediately if a deficiency noted during operation, would damage the equipment if operation were continued. All deficiencies and shortcomings will be recorded, together with the corrective action taken, on DA Form 2404 (Equipment Inspection and Maintenance Worksheet) at the earliest possible opportunity.

3-5. Daily Preventive Maintenance Checks and Services

The daily preventive maintenance checks and services which must be performed by the operator are tabulated in table 3-1. The item numbers indicate the sequence of minimum inspection requirements.

3-6. Quarterly Preventive Maintenance Checks and Services

Table 3-1 tabulates the quarterly preventive maintenance services which must be performed by organizational maintenance personnel. A quarterly interval is equal to 3 calendar months, or to 250 hours of operation, whichever occurs first. The item numbers indicate the sequence of minimum inspection requirements.

Figure 3-1. Not used.

Table 3-1. Preventive Maintenance Checks and Services

Item number	Interval						B — Before operation D — During operation	A — After operation W — Weekly	M — Monthly Q — Quarterly
	Operator				Org.				
	Daily				M	Q	Item to be inspected	Procedure	Reference
	B	D	A	W					
1	X						Fan louver	Clean if dirty.	
2	X						Ground terminal	Check for proper ground, consisting of a 5/8 inch-diameter solid rod, 9 ft long. The cable will be No. 6 AWG copper wire, bolted or clamped to the rod and attached to the ground terminal of the welder.	Para 2-4*c* & *d*
3	X	X					Controls	Inspect for damage and loose mounting. With unit operating, check for proper operation. Turn once through their complete range to keep the rheostat windings and contact points free of oxidation.	
4	X						Exterior surface	Check for dirt, scratches, dents, or damage to panels and surfaces. Clean if required.	
5	X						Knobs	Check for loose, broken, or missing control knobs on front panel.	
6		X					Panel lamps	During normal operation check panel lamps. Replace if they do not light.	para. 3-8*b*.
7	X						Water and gas fittings	For normal TIG operation, check for tight fittings, free from leaks or loose mounting.	
8	X						Cables	Check for frayed or broken insulation. Replace if required.	
9		X					Operation	During operation, check for any unusual noise or vibration.	
10			X				Publications	Make sure that a copy of TM 5-3431-228-15 is with the welding machine and is in readable condition.	
11						X	Fan motor, fan, and louvers	Clean louvers. Tighten loose motor, fan mounting, and electrical connections. Replace defective fan motor or fan.	
12						X	Main contactor	Tighten loose mounting and electrical connections. Replace defective contactor.	para 3-33.
13						X	Solenoid valves and fittings.	Inspect for leaks. Tighten loose mounting and electrical connections. Replace defective valves and fittings.	para 3-34.
14						X	Controls	Replace damaged controls. Tighten loose mounting. With the welder operating, check for proper operation	para 3-23, 3-25, 3-27.
15						X	Transformers	Clean by blowing out dust and dirt with clean, dry, air stream.	
16						X	Rectifiers	Remove dust and dirt with clean, dry air stream. Blow through and not across selenium rectifier plates.	

Section III. OPERATOR'S MAINTENANCE

3-7. General

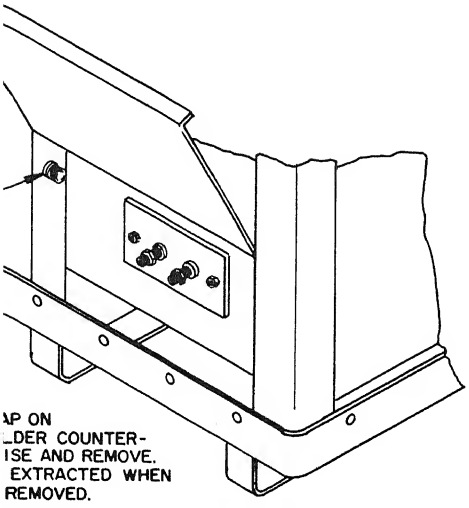
This section describes maintenance activities assigned to the operator in addition to those described in paragraph 3-5.

3-8. Replacing Parts

a. Control Circuit Fuse F1. Refer to figure 3-2 for removal and installation instructions.

b. Pilot Lamps. Refer to figure 3-3 for removal

ı of pilot lamps.



3-2. Removing and installing fuse F1.

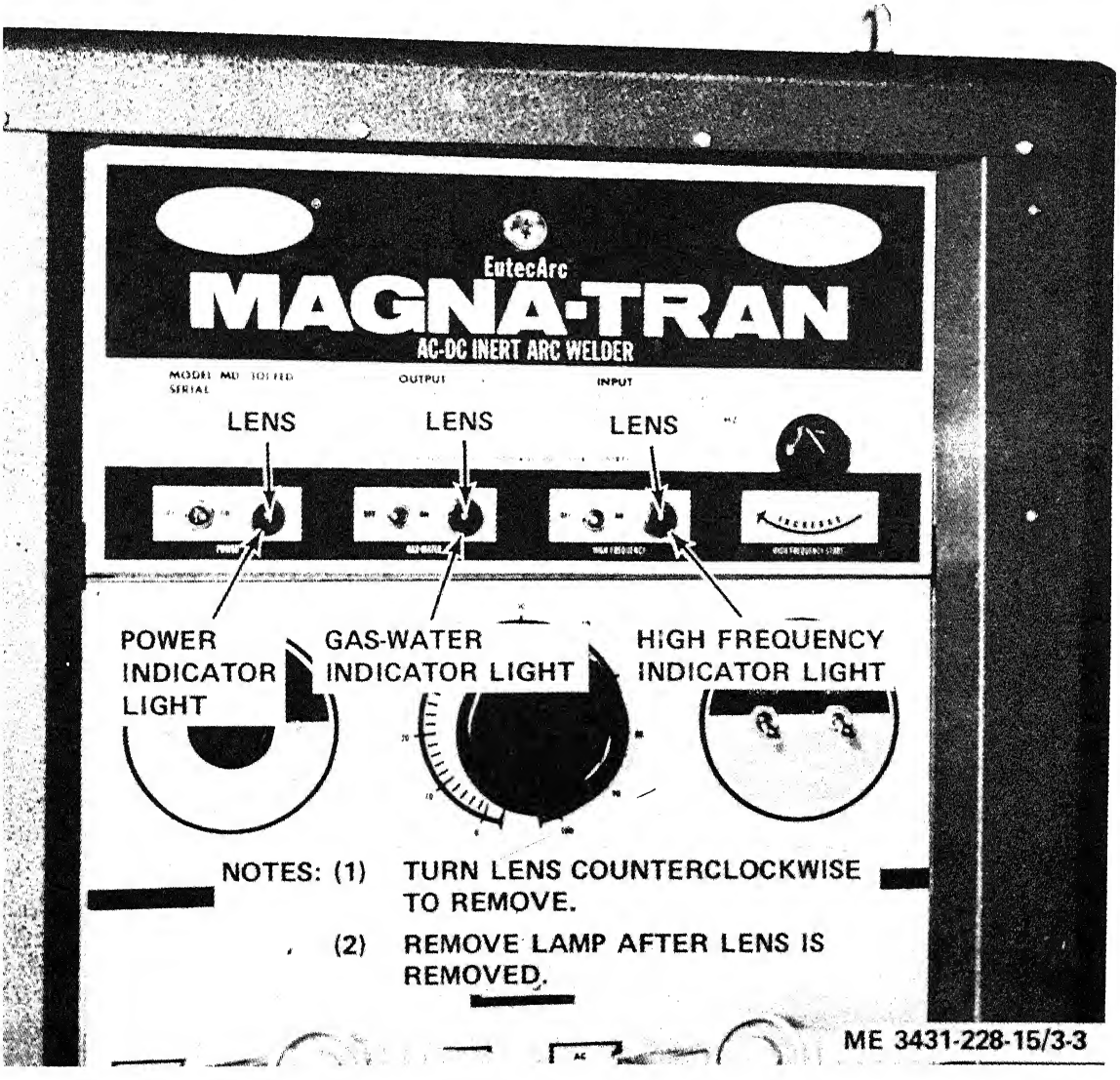


Figure 3-3. Removing and installing pilot lamps.

Section IV. TROUBLESHOOTING

3-9. General

This section provides useful information in diagnosing and correcting unsatisfactory operation or failure of the welding machine and its components. Malfunctions which may occur are listed in table 3-2. Each trouble symptom is followed by a list of prob able causes. The recommended corrective action i correlated to each probable cause. Any trouble be yond the scope of organizational maintenance sha be reported to direct support maintenance. (table 3-2

Table 3-2. Organizational Troubleshooting

Item no.	Malfunction	Probable cause	Corrective action
1	Welding machine fails to start, POWER lamp does not light	*a.* Loose connector	*a.* Check 10-pin connector
		b. Open Drawer	*b.* Close drawer securely
		c. Defective interlock switch	*c.* Check and replace if necessary (para 3-
		d. Defective line fuses	*d.* Check the power source fuses. Replace necessary (para 3-8).
		e. Incorrect source voltage	*e.* Check jumper bars at contactor to agre with source: 230 vac or 460 vac.
		f. Defective POWER switch or power relay K5.	*f.* Set POWER switch to ON and hold fo several seconds. If fan does run and POW lamp does not light, check wiring, POWE switch, and relay. Replace POWER switc relay if necessary. (para 3-23).
2	Arc will not start, but POWER light is illuminated.	*a.* Incorrect switch settings.	*a.* Check AMPERAGE switch and CON- TACTOR switch. Be sure they are in the (PANEL CONTROL) position when the remote foot control is not used. Check positions of RANGE switch and POLAI SWITCH.
		b. Missing pre-flow timer.	*b.* When a timer is removed, place the du plug in the socket to complete normally contact connections.
		c. Welding machine overheated.	*c.* Allow machine to cool until thermos permits contactor to operate.
		d. Defective thermostat.	*d.* Replace thermostat. (para 3-28).
		e. Other causes.	*e.* Refer other causes to direct and gene support maintenance personnel.
3	Cooling fan does not operate.	*a.* Lead broken or terminal loose.	*a.* Repair or tighten terminal;
		b. Fan motor defective.	*b.* Replace motor. (para 3-37).
4	Fan assembly noisy.	*a.* Mounting hardware loose.	*a.* Tighten hardware.
		b. Fan blade loose.	*b.* Tighten fan blade setscrew.
5	Insufficient gas.	*a.* Lines or fittings obstructed.	*a.* Clean lines and/or fittings.
		b. Solenoid valve defective.	*b.* Replace solenoid valve (para 3-34).
6	Insufficient water.	*a.* Lines or fittings obstructed.	*a.* Clean lines and/or fittings.
		b. Solenoid valve defective.	*b.* Replace solenoid valve (para 3-34).
7	Indicator lights inoperative.	*a.* Lamp burned out.	*a.* Replace lamp.
		b. Lead broken or connection loose.	*b.* Repair lead or tighten connection.
		c. Socket defective.	*c.* Replace socket. (para 3-22).
8	Welding machine operates erratically when using high frequency.	Spark gap improperly adjusted.	Clean adjusting screws and adjust spark (para 3-29).
9	Gas and water both continue to flow after completing welding.	Defective post-flow timer.	Remove timer and replace. (para 3-31)
10	High frequency will not drop out after arc starts.	*a.* Improper switch setting.	*a.* Open drawer and set HIGH FREQU dropout switch to START ONLY po
		b. Defective pilot relay K1 or associated circuit.	*b.* Higher level maintenance required.
		c. Missing dummy plug in high-frequency timer socket.	*c.* Install dummy plug. Refer to schei diagram.
11	High frequency does not appear at output. HIGH FREQUENCY light is illuminated.	*a.* Misadjusted or defective spark gap.	*a.* Clean and adjust the spark gap. (pa
		b. Disconnect banana plug in high voltage lead.	*b.* Check connections and press tight together.
		c. HIGH FREQUENCY START control in maximum counterclockwise position.	*c.* Adjust as necessary.

Table 3-2. Organizational Troubleshooting — Continued

Item no.	Malfunction	Probable cause	Corrective action
		d. Secondary cables are coiled up and the high frequency is reduced.	*d.* Uncoil ground and/or electrode cables.
		e. Other causes	*e.* Refer other causes to direct or general support maintenance personnel.
12	WELD AMPERES control does not affect current in each range. Output is the minimum value of the range setting.	*a.* Fuse F1 is blown.	*a.* Check and replace if necessary (para 3-8).
		b. AMPERAGE switch in REMOTE RECEPTACLE position.	*b.* Place switch in PANEL CONTROL position.
		c. Other causes	*c.* Refer other causes to direct or general support maintenance personnel.
13	Secondary welding current shuts off.	Spot arc timer is operating.	Check and set as required. If continuous operation is desired, place SPOT ARC switch in the OFF position.
14	Remote control does not function properly.	*a.* Wires loose at receptacle.	*a.* Tighten wires
		b. Receptacle defective.	*b.* Replace receptacle (para 3-26).
		c. Remote contactor switch defective.	*c.* Replace switch (para 3-27).
		d. Remote amperage switch defective.	*d.* Replace switch. (para 3-27).

SECTION V. FIELD EXPEDIENT REPAIRS

3-10. General

Operator and organizational maintenance troubles may occur while the welding machine is operating in the field where supplies and repair parts are not available and normal corrective action cannot be performed. When this condition exists, the following expedient repairs may be used in emergencies upon the decision of the unit commander. Equipment so repaired must be removed from operation as soon as possible and properly repaired before being placed in operation again.

3-11. Loss of Water

Trouble	*Expedient remedy*
Pipe or fitting cracked	Tape cracked pipe or fitting until defective pipe or fittings can be replaced.

3-12. High Frequency Inoperative

Trouble	*Expedient remedy*
Timer defective	Exchange timers until defective timer can be replaced.

3-13. Power Failure

Trouble	*Expedient remedy*
a. Interlock switch defective	Use jumper wire to bypass interlock switch until it can be replaced.
b. Contactor broken or defective	Provide jumper wire around contactor until it can be replaced.

Section VI. ORGANIZATIONAL MAINTENANCE PROCEDURES

3-14. General

a. This section contains a complete description of the welding machine. The function of each timer and relay is described. Refer to the schematic diagram (fig. 7-2) for the complete circuit.

b. This section also describes disassembly, repair, and replacement procedures for organizational maintenance.

3-15. Power on Conditions

a. When the welding machine is connected to the ac power line, the primary and secondary windings

of control transformer T2 have voltages present at all times. Transformer T2 has two secondary windings, one for 24 volts and one for 230 volts. The 24-volt winding is used primarily to operate the timers and energize the coil on most of the relays. The 230-volt winding supplies power for the fan, the solenoid valves, the main contactor, the panel lamps, and the high voltage transformer. When the POWER switch is off, the 24 volt circuit is interrupted and neither the 230 volts or the 24 volts activate any circuits, except the soft start relays described elsewhere.

b. Placing the POWER switch in the ON position energizes power relay K5. Contacts 6-8 close and supply holding current to K5 after the POWER switch is released. Contacts 1-3 of K5 close and connect 230 vac to the fan motor and POWER indicator lamp DS1. The 230 volts is also applied, through normally closed contacts 1-4 of the post-flow timer to GAS-WATER switch S4. If the switch is in the ON position, GAS-WATER indicator lamp DS2 lights and the gas and the water solenoid valves are energized. This permits gas and water to appear at the torch for TIG welding.

c. To operate the main contactor and apply power to transformer T1, control relay K6 must be energized.

d. Assume that CONTACTOR switch S2 is in the PANEL CONTROL position, causing control relay K6 to be energized, closing contacts 1-3. This applies 230 volts through contacts 6-8 of the pre-flow timer, through contacts of the spot arc timer and through the thermostat to the coil of contactor K8. If the CONTACTOR switch is in the REMOTE RECEPTACLE position, the remote foot control switch must be closed to apply 24 volts to the coil of control relay K6.

e. When main contactor K8 is energized, the ac power line is connected to the primaries of transformer T1. This transformer supplies the output current for welding.

3-16. Timer Functions (fig. 2-5)

a. Pre-flow Timer M2. This timer is energized when control relay K6 is energized. When the timer is used, it delays application of 230 volts to the main contactor and the high voltage unit. During the delay time, the gas and water solenoid valves are energized. This permits the gas and water to purge the lines, and permits the gas to purge the work area before the arc is struck. The delay is adjustable from 1 to 30 seconds. At the end of the delay time, contacts on the timer close and apply power to the contactor through contacts of the spot arc timer.

b. Spot Arc Timer. Spot arc timer M4 is used in conjunction with the proper torch where inert gas-shielded arc spot welding operation is desired. This timer controls the length of time that the welding arc is ON. Normally the preflow purge is not used and high frequency is used continuously. When this timer function is not being used, SPOT ARC switch S7 must be set to OFF to disable the timer. When pre-flow timer M2 is also being used, contacts 1-3 of M2 close and apply power to M4 after the preflow delay time. The current path for energizing the spot arc timer is through normally closed contacts 1-4 of pilot relay K1. When the pilot relay is energized, the spot arc timer is disabled due to opened contacts 1-4 on the relay.

c. Post-Flow Timer. The post-flow timer M1 continues the flow of shielding gas and water after the welding arc is broken, to provide protection to the hot tungsten electrode and TIG torch. This timer is adjusted from 1-30 seconds, depending upon the size of the electrode, the current used, and the time required for the tungsten electrode to cool down without oxidizing. The post-flow function should always be used when TIG welding. When stick electrode welding, this function is not needed and can be deactivated without disturbing the setting on the timer by placing the GAS-WATER switch in the OFF position. When control relay K6 de-energizes, contacts 8-5 close and operate the postflow timer. The timer contacts 1-4 close, keeping water and gas solenoid valve operated for the desired time.

3-17. Relay Functions

a. Power Relay K5. This relay must be energized to start the welding machine. If the timer drawer interlock switch is closed, placing the POWER switch in the ON position energizes the relay. When the POWER switch is released, the contacts are as illustrated in the schematic diagram. Contacts 6-8 close and supply holding current to keep the relay energized until the power is removed or until the POWER switch is placed in the OFF position. When K5 is energized, contacts 1-3 are closed and 230 vac is applied to the fan motor and to POWER indicator light DS1.

b. Control Relay K6. After power relay K5 is energized, control relay K6 must be energized. This is accomplished by closing the CONTACTOR switch (PANEL CONTROL position) or closing remote foot control switch, which applies 24 vac to the relay. Contacts 5-8 of K6 then open, disconnecting power from the post-flow timer, and contacts 1-3 close. Relay K6 contacts 1-3 now permit operation to start, depending upon the condition of the pre-flow timer and the spot arc timer.

c. Main Contactor K8. This coil actuated contactor applies the ac line voltage to transformer T1 when it is energized. The contactor coil is energized by the

230 vac secondary voltage from transformer T2. When relay K5 and K6 are energized, and timers M2 and M4 are as required, then 230 vac is applied to the coil of the contactor through a thermostatic switch. The closed contacts of K8 then apply power to transformer T1 and permits the arc to be established.

d. Pilot Relay K1.

(1) When the contactor is energized and transformer T1 receives power, pilot relay K1 becomes energized. This relay is energized by the dc voltage from bridge rectifier CR3. The ac voltage applied to the bridge, and the resulting dc voltage applied to K1, is dependent upon the output voltage at the electrode. The open circuit voltage at the electrode is higher than the voltage while the arc is established. Initially, therefore, relay K1 is energized when power is applied to T1, but drops out when the arc is struck due to the lowered voltage across the bridge rectifier.

(2) When K1 is initially energized, contacts 6-8 close and apply 230 vac to high frequency transformer T3, via the dummy plug and closed HIGH FREQUENCY switch S5. This results in a high frequency output at the torch electrode. When the arc is struck K1 becomes deenergized and contacts 6-8 open, dropping out the high frequency circuit.

(3) Pilot relay K1 also has another function. When power is applied to T1 and K1 becomes energized, contacts 1-3 close and apply 24 vac from the CONTACTOR switch S2 to diode CR1, which energizes relay K2 in the soft start circuit.

e. Soft Start Relays K2, K3, and K4.

(1) The soft start circuit employs three relays, K2, K3, and K4. When ac line-voltage is present at transformer T2, the 24 vac secondary voltage energizes soft start delay relay K2, through normally closed contacts of present relay K4. Soft start power relay K3, becomes energized through closed contacts of K2. Therefore, before the POWER switch is turned ON, K2 and K3 are energized and K4 is deenergized.

Note. Diode CR1 conducts on each half cycle, charging capacitor C2 which holds K2 energized.

(2) When the POWER switch and CONTACTOR switch are turned on and ac is applied to transformer T1, an ac voltage appears across the ac control winding secondary. This quickly energizes soft start, preset relay K4, which removes 24 vac from the coil of K2. Relay K2 remains energized however, because pilot relay K1 now becomes energized and applies 24 vac to K2 via contacts 1-3 on K1. The charged capacitor, C2, across the coil of K2 develops the time delay for the soft start. Relays K2 and K3 are now energized, with K2 being controlled by K1. During this condition, the center tap on the ac control winding of T1 is connected to terminal 1 of SOFT START/STANDARD START switch S8. When the switch is in the SOFT START position, the control rectifier CR2 receives only half the normal ac voltage. The resulting dc voltage applied to the control coils on T1 is only half normal.

(3) When the arc is struck, pilot relay K1 releases and removes 24 vac from K2. Capacitor C2 begins to discharge, and after a 2 second delay, relay K2 releases. When K2 releases, the 24 vac is removed from the coil of K3, causing relay K3 to release. This connects the entire ac control winding across control rectifier CR2 and results in a standard output.

f. Overload Relay K7. This relay protects the welding machine against excessive current delivered by transformer T1. The coil is located in the primary winding of T1. When excessive current is being drawn, K7 is energized. Normally closed contacts on K7 open and remove the 24 vac output of T2 from power relay K5. Relay K5 then becomes deenergized and removes power from contactor K8, shutting down the welding machine output. Observe that when the contactor releases, the primary circuit of T1 is opened and overload relay K7 is released. This reapplies 24 vac to the POWER switch and contacts of power relay K5. Relay K5 is not energized, however, until the POWER switch is placed in the ON position.

3-18. High Frequency Circuit

a. The high frequency circuit consists of high voltage transformer T3, a spark gap, rheostat R5, capacitor C9 and tesla coil T4. When 230 vac is applied to the primary of T3, a high voltage appears across the spark gap and R5, which are in series. The spark gap is adjusted to maintain an arc across the gap, which results in a high frequency signal across the gap. This signal is coupled by C9 to transformer T3, where it is imposed upon the welding current. The intensity of the high frequency appearing at the output is controlled by R5.

b. When AC welding is being used, the high frequency appears superimposed on the ac waveform. When the ac waveform voltage momentarily becomes zero at each half cycle, the high frequency components is still present and helps to prevent the arc from extinguishing.

3-19. Timer and High Frequency Drawer

a. Removal. Proceed as follows to remove the drawer for replacement.

(1) Disconnect ac power from the welding machine.

(2) With the key, unlock the front panel door and open it.

(3) Disconnect the door-stop bar from the stop screw in the upper left corner and lower the front panel.

(4) Refer to figure 3-4 and remove the high frequency and timer drawer.

b. Installation.

(1) Refer to figure 3-4 and install the high frequency and timer drawer.

(2) Be sure the 10 pin connector and the two banana plugs are firmly seated.

(3) Close and lock the door.

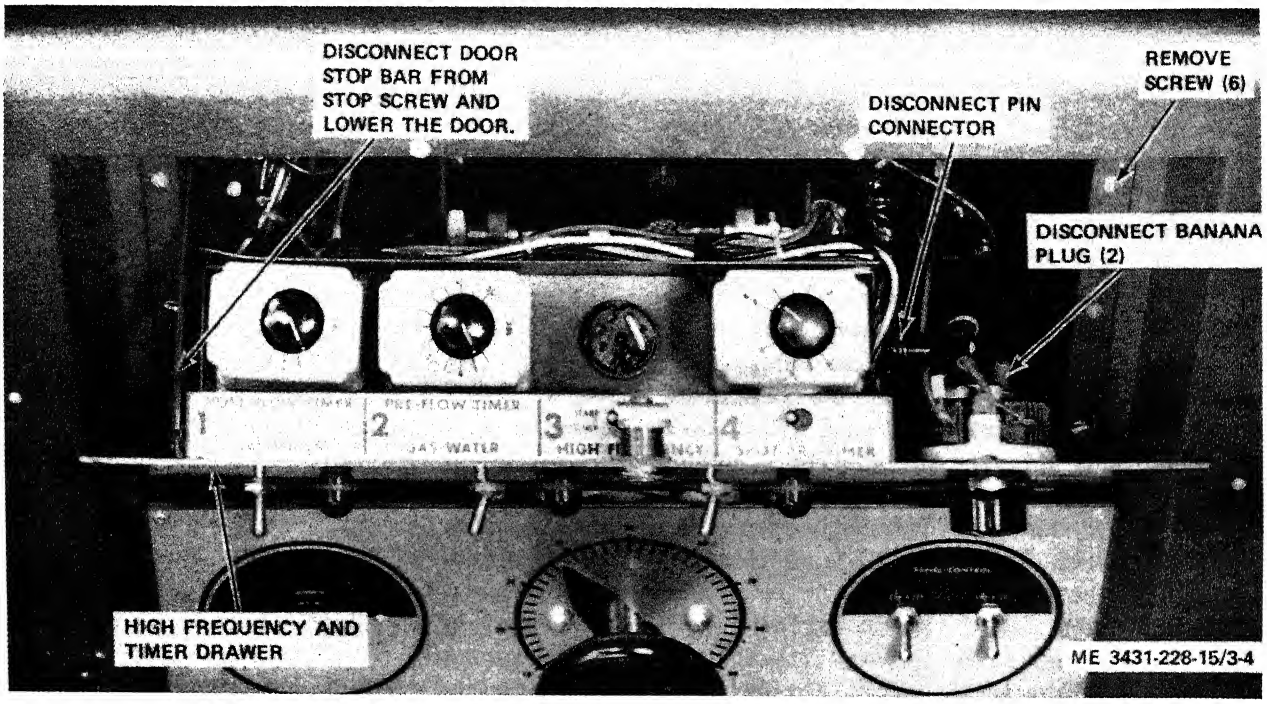


Figure 3-4. High frequency and timer drawer, removal and installation.

3-20. Welding Machine Top and Housing

***Caution:* Never under any circumstances operate the welding machine with the top and/or side housing removed. In addition to the safety hazard, improper cooling may result in damage to the power transformer and welding machine components.**

a. Removal. Proceed as follows to remove the top and the housing from the welding machine.

(1) Disconnect ac power from the welding machine.

(2) Refer to figure 3-5 and remove the welding machine top.

(3) Remove the four screws holding the fan assembly to the rear panel.

(4) Remove the gas and water solenoid valves (para 3-34).

(5) Refer to figure 3-5 and remove the housing.

b. Installation.

(1) Refer to figure 3-5 and install the housing.

(2) Install the gas and water solenoid valves (para 3-34).

(3) Install the four screws attaching the fan assembly to the rear panel.

(4) Refer to figure 3-5 and install the welding machine top.

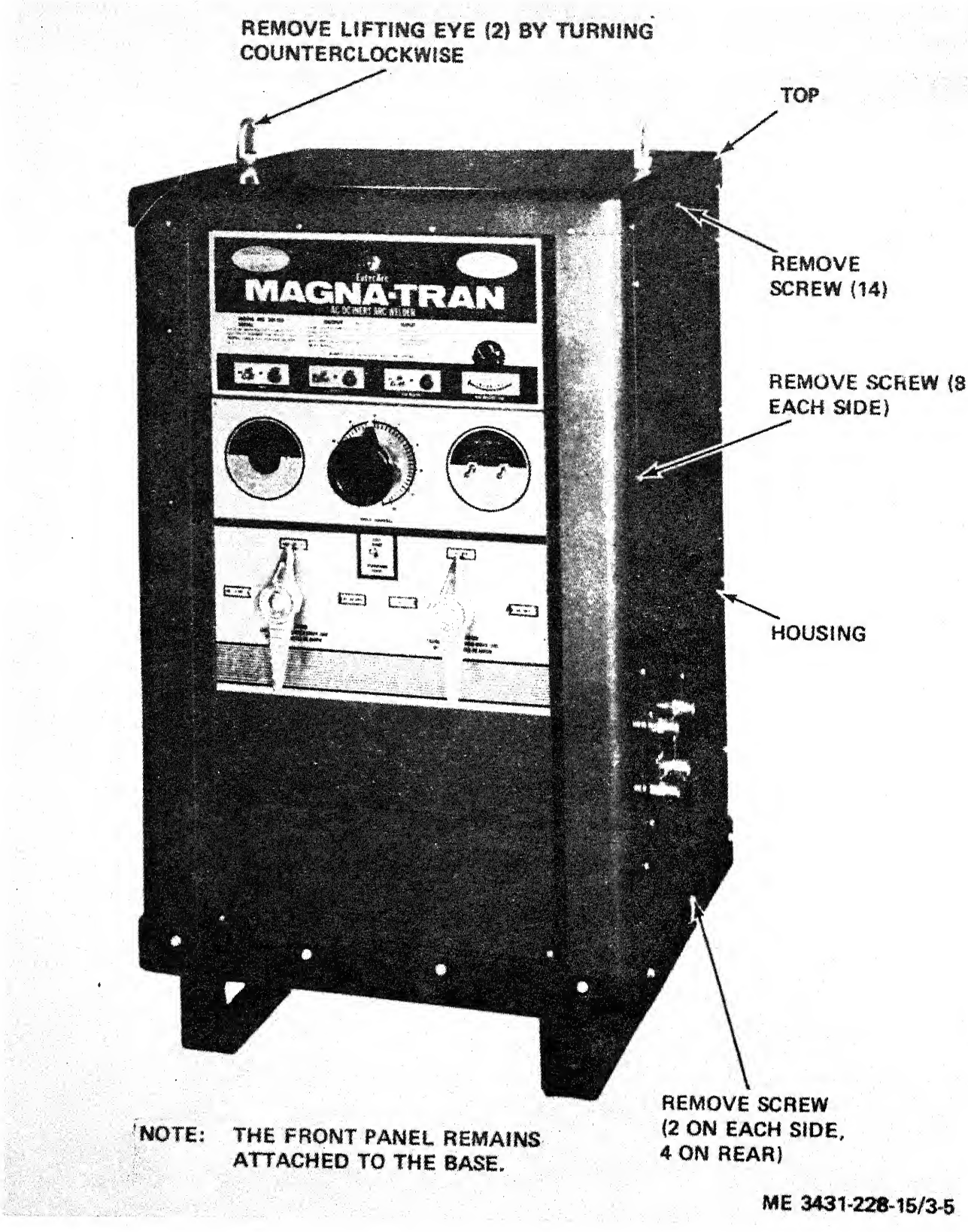


Figure 3-5. Welding machine top and housing, removal and installation.

3-21. Panel Lock

a. Removal. Proceed as follows to remove the lock from the panel door on the timer and high frequency drawer.

(1) Unlock the panel door and open it.

(2) Refer to figure 3-6 and remove the lock.

b. Installation.

(1) Refer to figure 3-6 and install the lock in the

door.

(2) Close and lock the panel door.

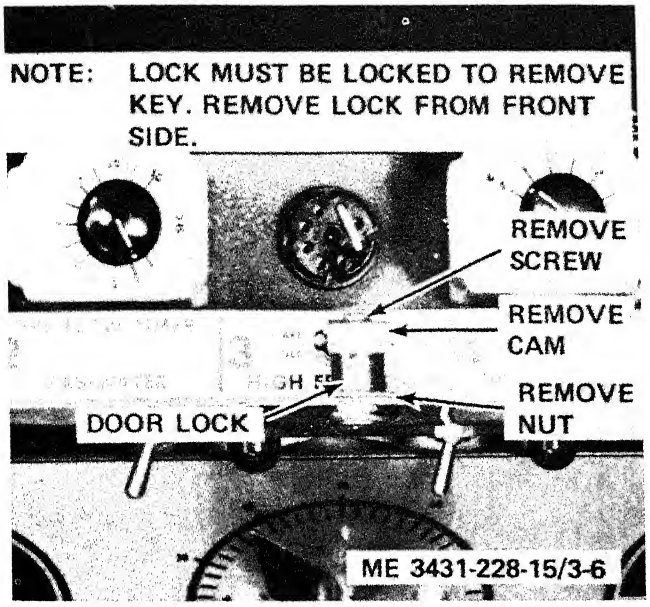


Figure 3-6. Door lock, removal and installation.

3-22. Pilot Lights

a. Removal. Proceed as follows to remove any one of the three pilot lights on the front panel.

(1) Disconnect ac power from the welding machine.

(2) Remove the pilot lamps (para 3-8b).

(3) Remove the timer and high frequency drawer (para 3-19) to obtain access to the interior.

(4) Refer to figure 3-7 and remove the pilot lights.

b. Installation.

(1) Refer to figure 3-7 and install the pilot lights.

(2) Install the timer and high frequency drawer (para 3-19).

(3) Install the pilot lamps (para 3-8b).

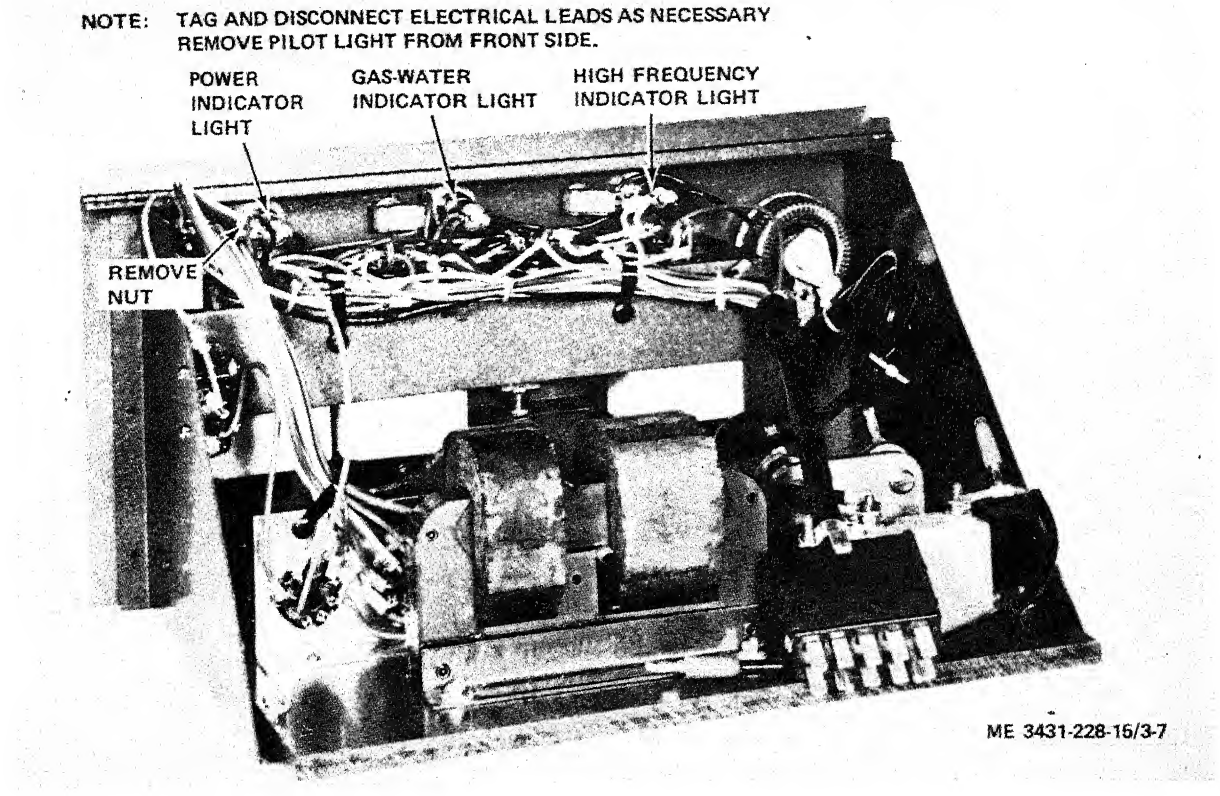


Figure 3-7. Pilot lights, removal and installation.

3-23. POWER, GAS-WATER, and HIGH FREQUENCY Switches

a. Removal. Proceed as follows to remove any one of the three switches from the front panel.

(1) Disconnect ac power from the welding machine.

(2) Remove the timer and high frequency drawer (para 3-19).

(3) Refer to figure 3-8 and remove the switch.

b. Installation.

(1) Refer to figure 3-8 and install the switch.

(2) Install the timer and high frequency drawer (para 3-19).

Figure 3-8. Power, gas-water, and high frequency switches, removal and installation.

3-24. Interlock Switch

a. Removal. Proceed as follows to remove the interlock switch.

(1) Disconnect ac power from the welding machine.

(2) Remove the timer and high frequency drawer (para 3-19).

(3) Refer to figure 3-9 and remove the interlock switch.

b. Installation.

(1) Refer to figure 3-9 and install the interlock switch.

(2) Install the timer and high frequency drawer (para 3-19).

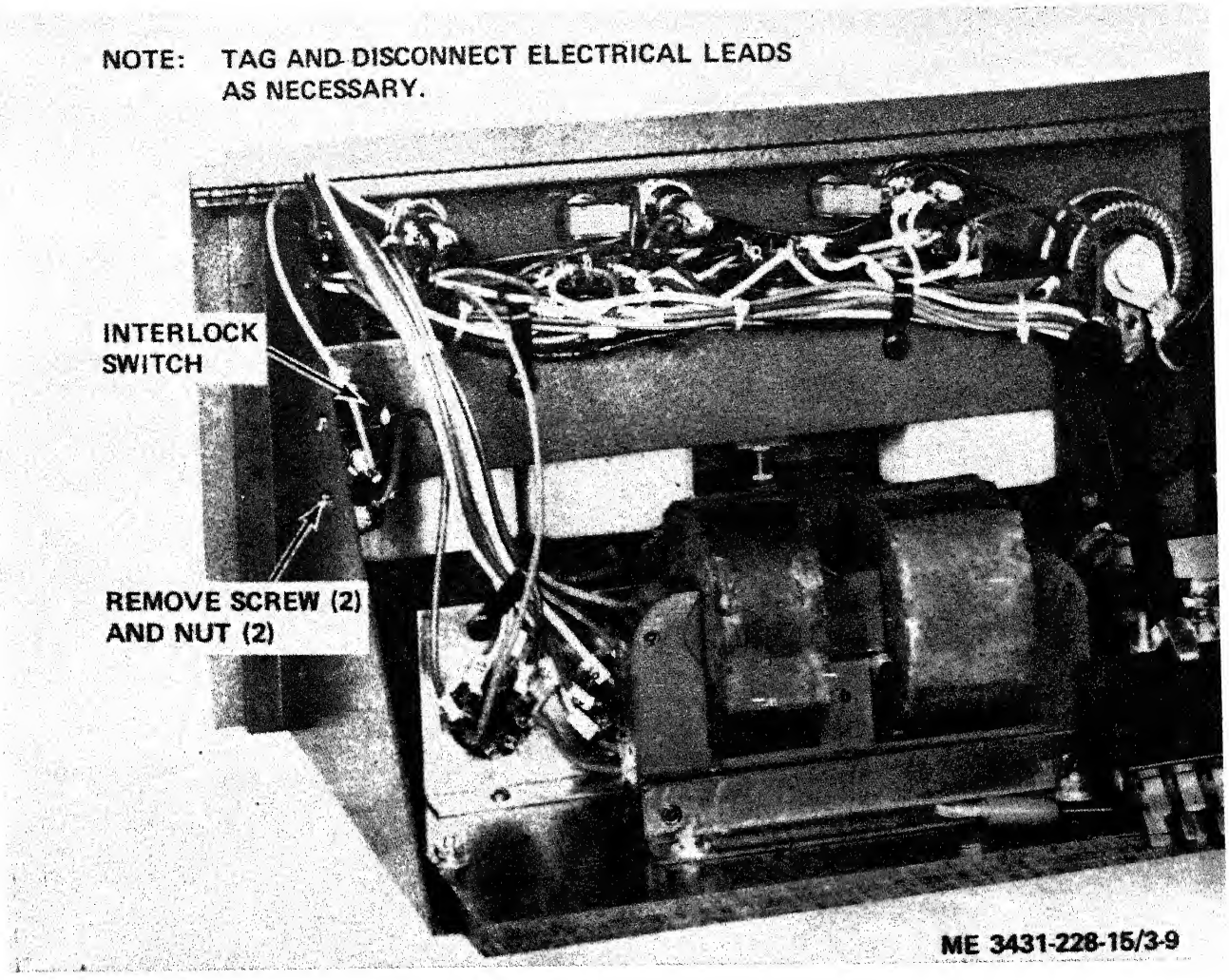


Figure 3-9. Interlock switch, removal and installation.

3-25. SPOT ARC and HIGH FREQUENCY Dropout Switches

a. Removal. These two switches are located in the timer and high frequency drawer, directly behind the front panel. Proceed as follows to remove either of them.

(1) Disconnect ac power from the welding machine.

(2) Remove the timer and high frequency drawer (para 3-19).

(3) Refer to figure 3-10 and remove the switch.

b. Installation.

(1) Refer to figure 3-10 and install the switches.

(2) Install the timer and high frequency drawer (para 3-19).

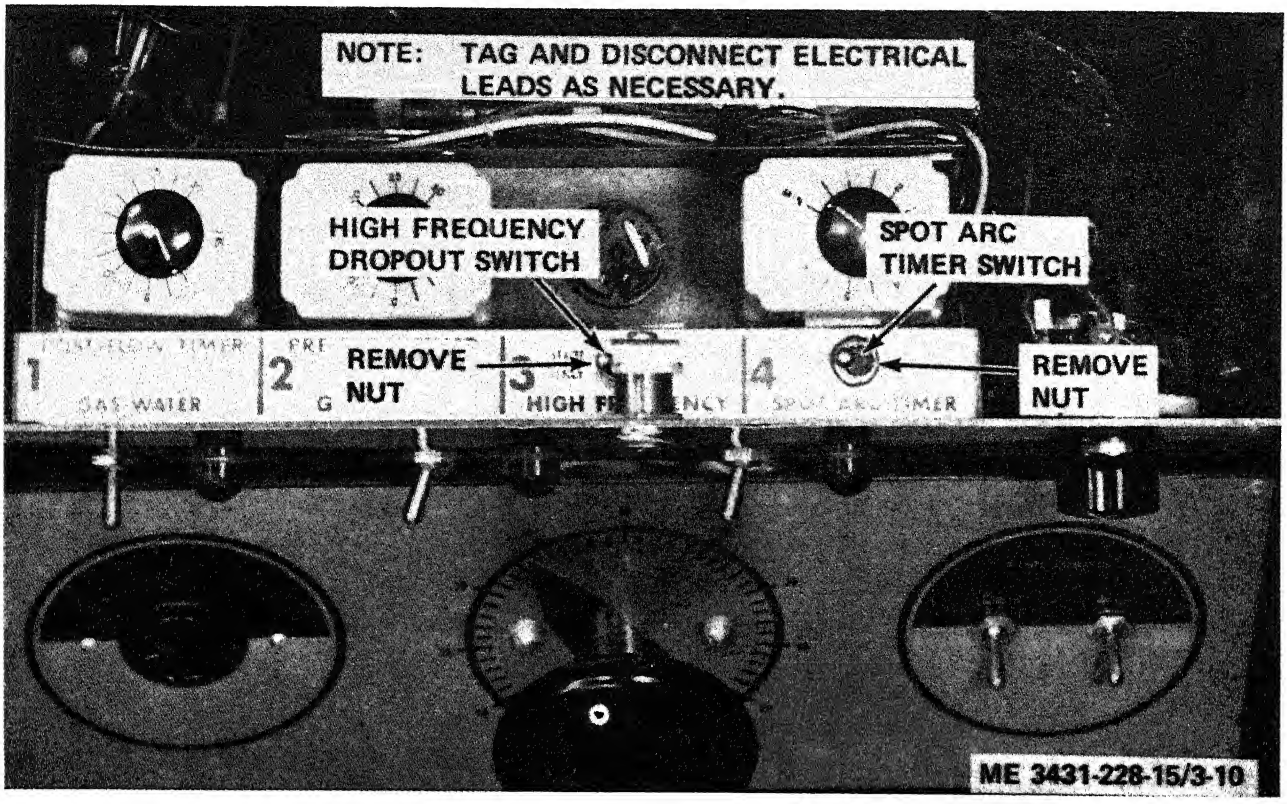


Figure 3-10. Spot arc and high frequency dropout switches, removal and installation.

3-26. REMOTE RECEPTACLE

a. Removal.

(1) Disconnect ac power from the welding machine.

(2) Remove the timer and high frequency drawer (para 3-19).

(3) Refer to figure 3-11 and remove the remote receptacle.

b. Installation.

(1) Refer to figure 3-11 and install the remote receptacle.

(2) Install the timer and high frequency drawer (para 3-19).

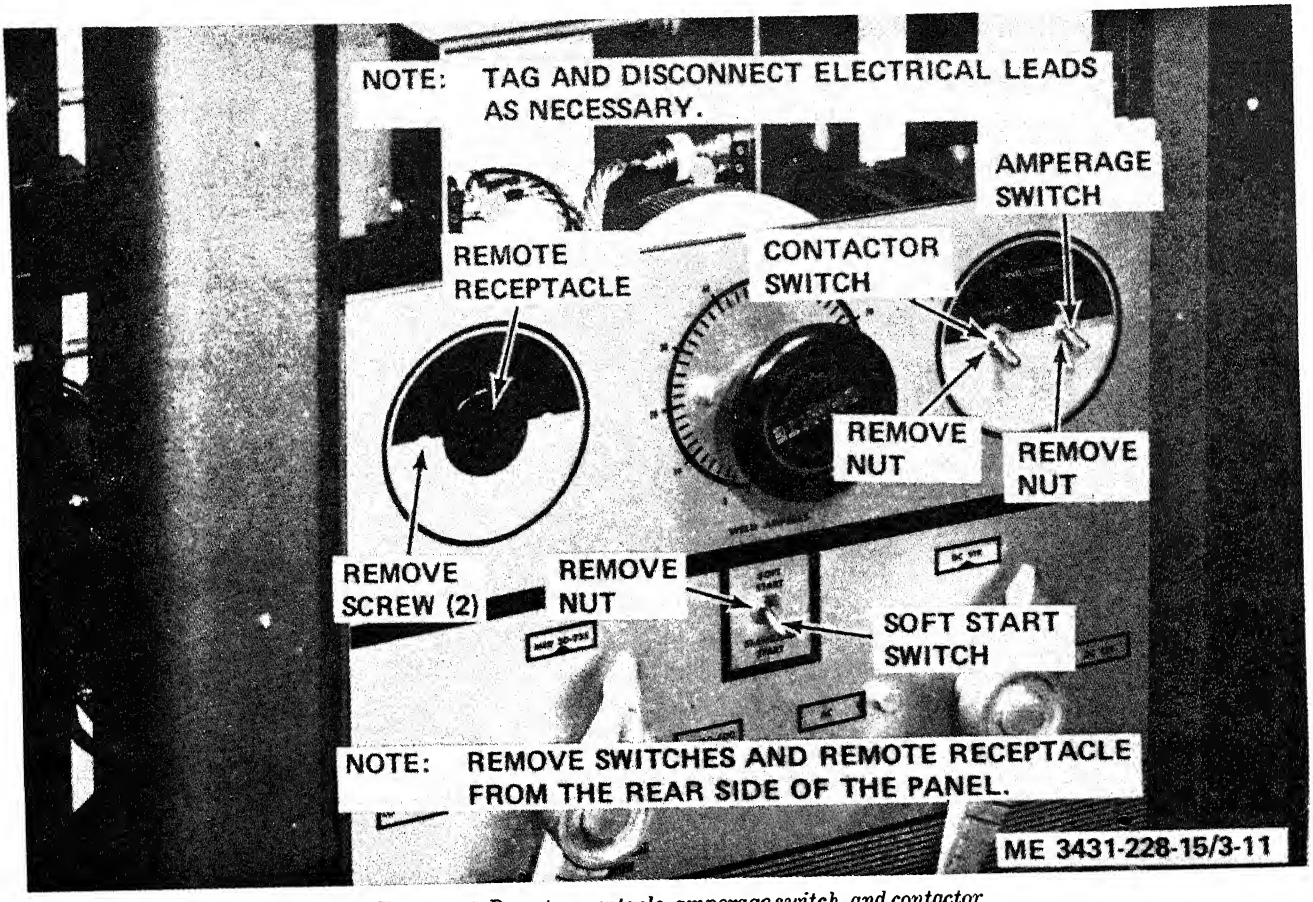


Figure 3-11. Remote receptacle, amperage switch, and contactor switch, removal and installation.

3-27. Remote AMPERAGE Switch, Remote CONTACTOR Switch, and SOFT START Switch

a. Removal. Proceed as follows to remove these front panel switches.

(1) Disconnect ac power from the welding machine.

(2) Remove the timer and high frequency drawer (para 3-19).

(3) Refer to figure 3-11 and remove the switch.

b. Installation.

(1) Refer to figure 3-11 and install the switch.

(2) Install the timer and high frequency drawer (para 3-19).

3-28. Thermostatic Switch

a. Removal. The thermostat responds to temperature in the welding machine transformer windings and opens the circuit to the contactor when heat becomes excessive. The thermostat is placed between the windings of transformer T1. Proceed as follows to remove the thermostat.

(1) Disconnect ac power from the welding machine.

(2) Remove the top and the housing from the welding machine (para 3-20).

(3) Refer to figure 3-12 and remove the thermostatic switch, being careful not to damage the transformer windings.

b. Installation.

(1) Refer to figure 3-12 and install the thermostatic switch.

(2) Install the top and housing (para 3-20).

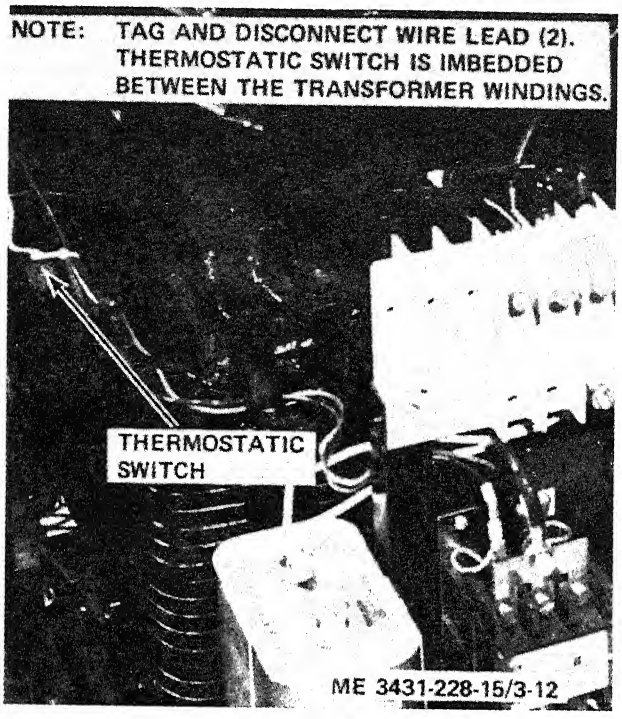


Figure 3-12. Thermostatic switch, removal and installation.

3-29. Spark Gap

a. Removal. The double spark gap is located in the timer and high frequency drawer, attached to the underneath side of the insulated top panel. Proceed as follows to remove the spark gap assembly.

(1) Disconnect ac power from the welding machine.

(2) Remove the timer and high frequency drawer (para 3-19).

(3) Refer to figure 3-13 and remove the spark gap assembly.

b. Installation.

(1) Refer to figure 3-13 and install the spark gap assembly.

(2) Install the timer and high frequency drawer (para 3-19).

c. Adjustment. Proceed as follows to adjust the spark gap. See figure 3-14.

(1) Disconnect ac power from the welding machine.

(2) Open the timer and high frequency drawer.

(3) Loosen the lockscrew on each spark gap in the spark gap assembly. These screws also hold the electrical leads to the spark gap assembly.

(4) Insert a 0.008 inch feeler gage between spark gap contact screws.

Note. If feeler gage is not available, close contact screws all the way and open 1/2 or 5/8 turn. Emergency situations only shall warrent adjustment without using a feeler gage. Readjustment, utilizing a feeler gage, shall be accomplished as soon as possible thereafter. Gaps exceeding 0.010 inch will emit excessive high frequency radio interference signals.

(5) Turn adjusting screw counterclockwise to increase gap and clockwise to decrease gap.

(6) Tighten lockscrew when a slight drag is felt as the gage is moved between the points.

(7) Close the timer and high frequency drawer.

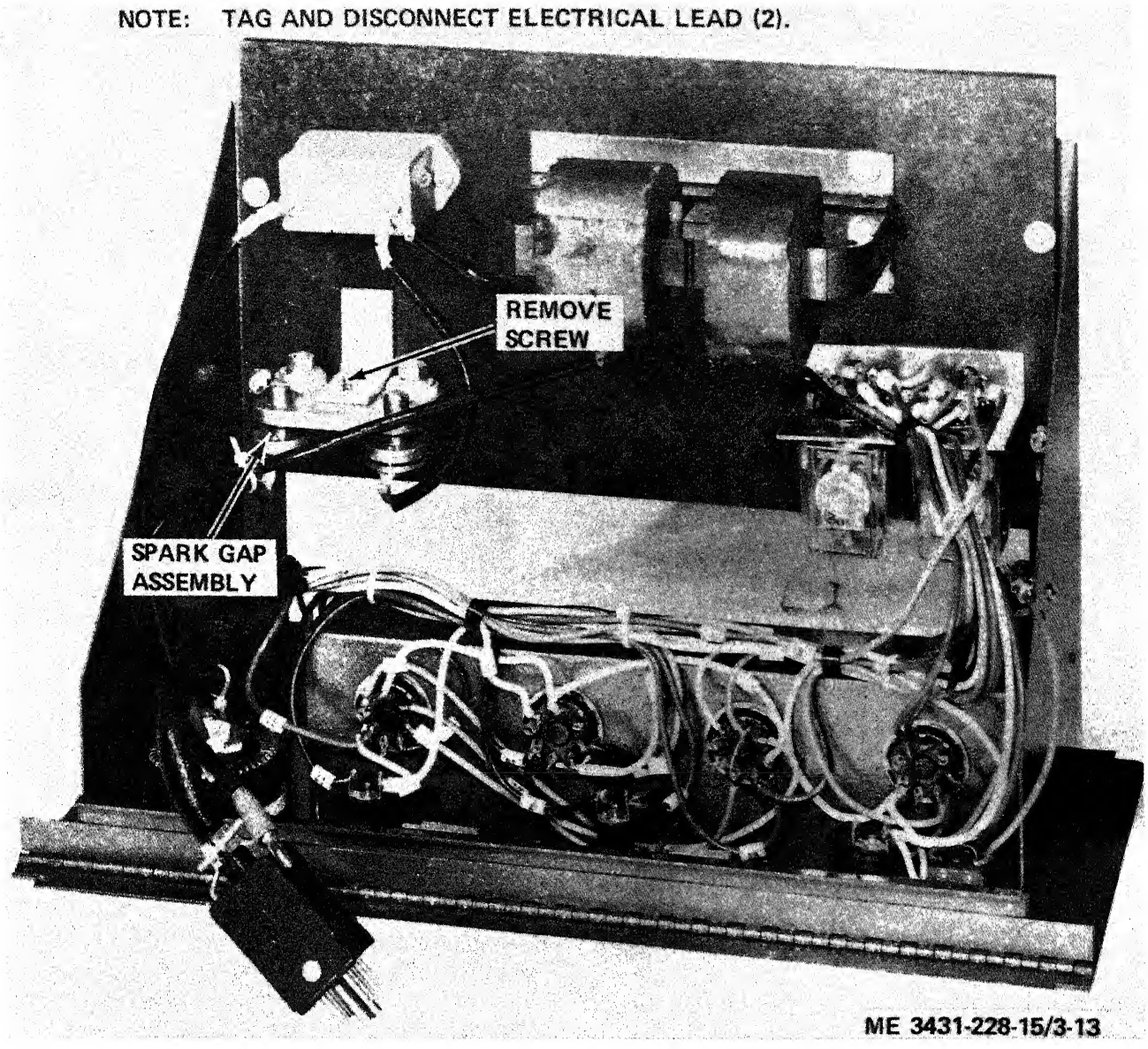


Figure 3-13. Spark gap assembly, removal and installation.

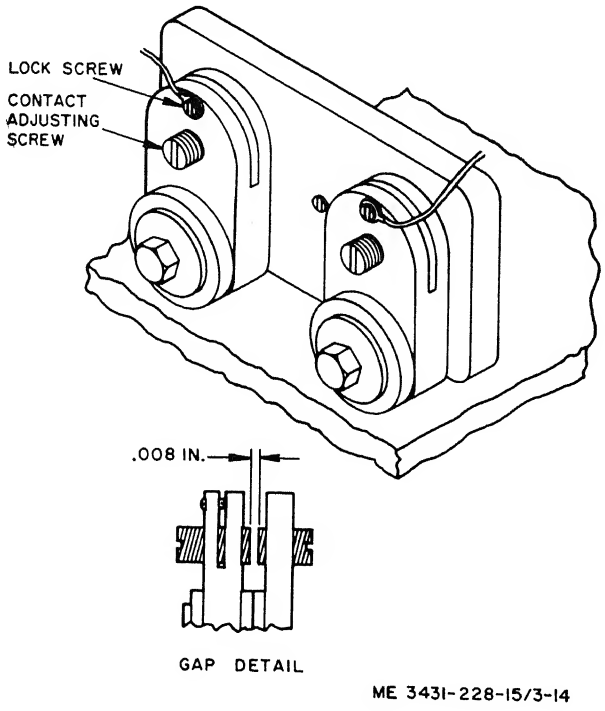


Figure 3-14. Spark gap adjustment.

3-30. Fuseholder

a. Removal.

(1) Remove the welder top and the housing (para 3-20).

(2) Refer to figure 3-15 and remove the fuseholder.

b. Installation.

(1) Refer to figure 3-15 and install the fuseholder.

(2) Install the top and housing on the welder (para 3-20).

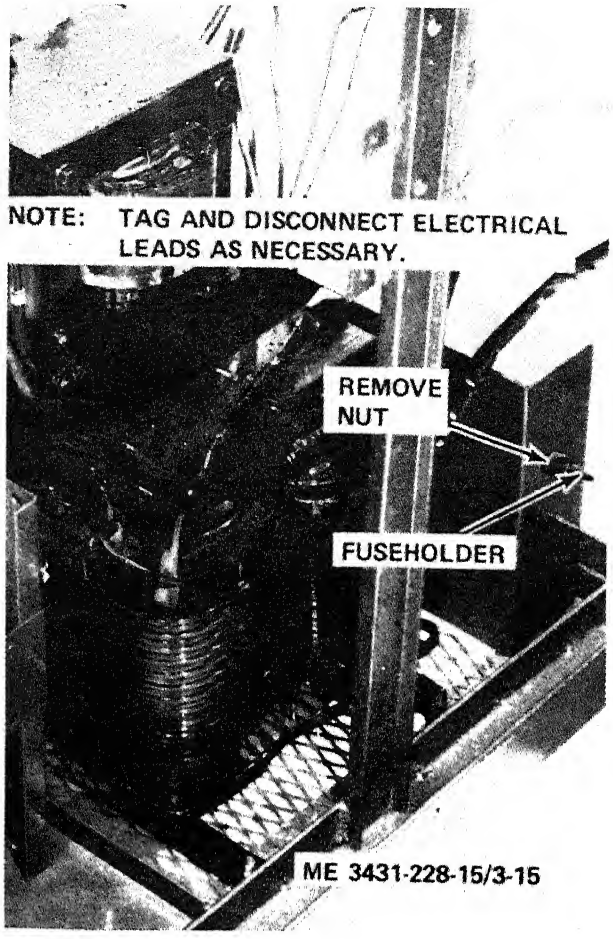


Figure 3-15. Fuseholder, removal and installation.

3-31. Timers

a. Removal. Refer to figure 3-16 and remove the timers.

b. Installation. Refer to figure 3-16 and install the timers.

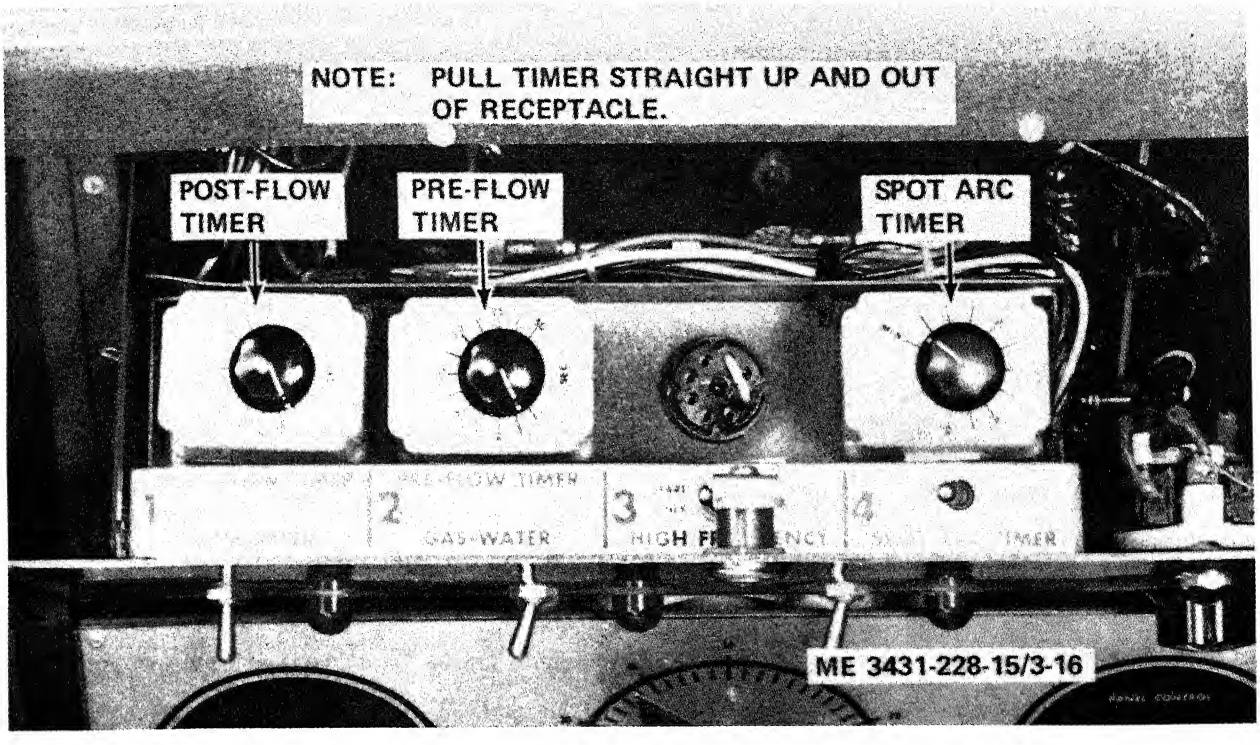


Figure 3-16. Timers, removal and installation.

3-32. Timer Receptacles

a. Removal.

(1) Remove the timer and high frequency drawer (para 3-19).

(2) Remove the timer (para 3-31).

(3) Refer to figure 3-17 and remove the timer receptacle.

b. Installation.

(1) Refer to figure 3-17 and install the timer receptacle.

(2) Install the timer (para 3-31).

(3) Install the timer and high frequency drawer (para 3-19).

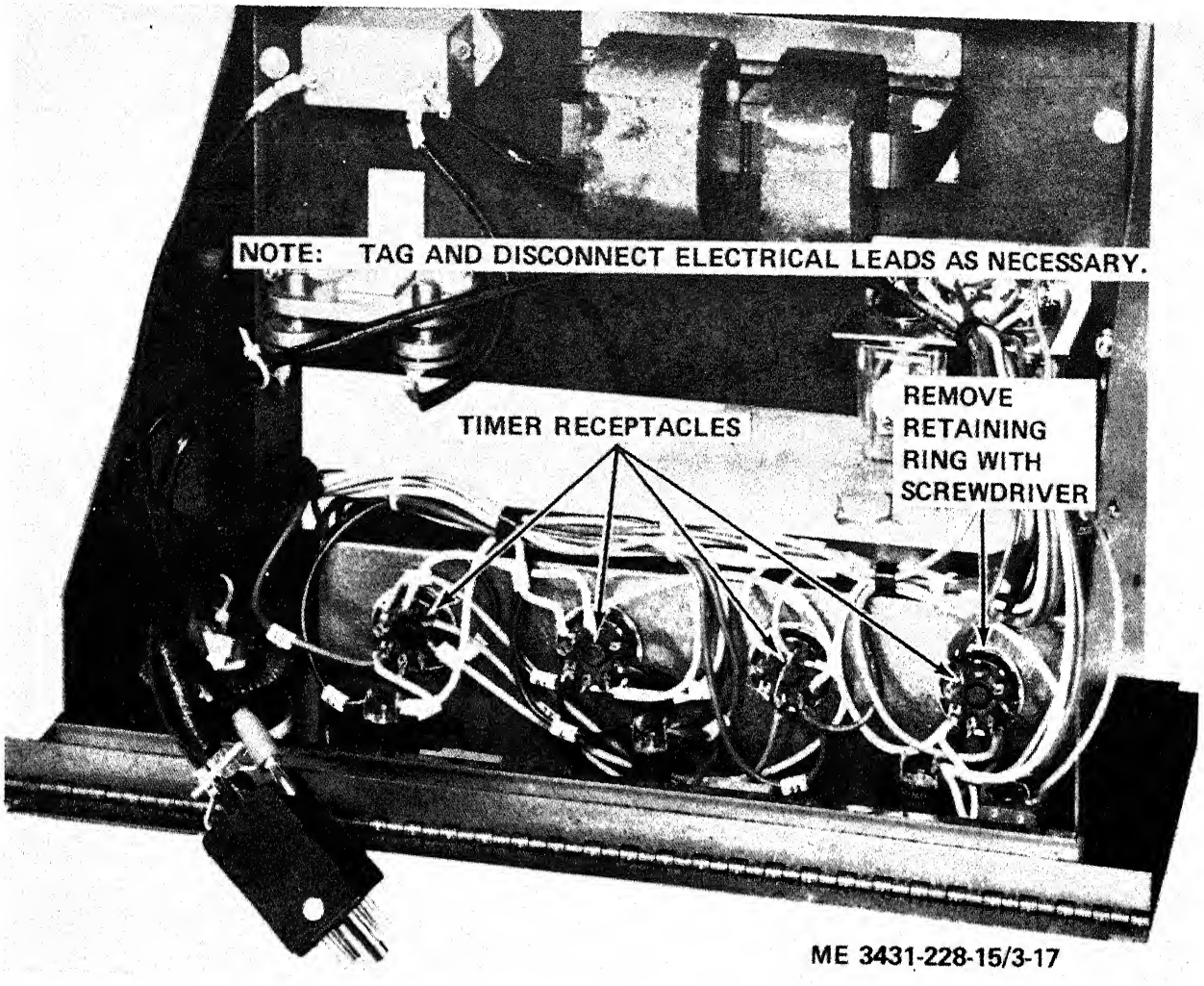


Figure 3-17. Timer receptacles, removal and installation.

3-33. Main Contactor, K8

a. Removal.

(1) Disconnect ac power from the welding machine.

(2) Remove the top and housing (para 3-20).

(3) Refer to figure 3-18 and remove the contactor.

b. Installation.

(1) Refer to figure 3-18 and install the contactor.

(2) Install the top and housing (para 3-20).

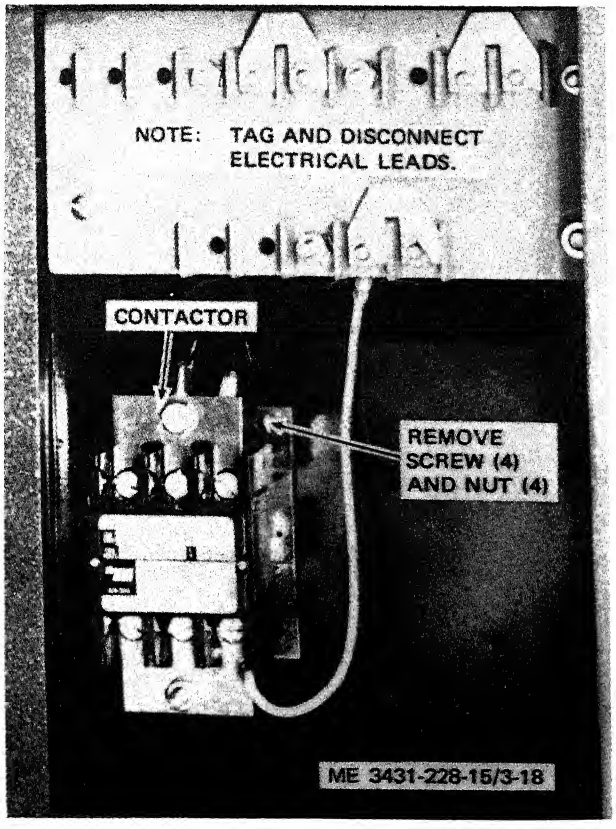


Figure 3-18. Main contactor, removal and installation.

3-34. Solenoid Valves

a. Removal. Refer to figure 3-19 and remove the gas or water solenoid valve.

b. Installation. Refer to figure 3-19 and install the gas or water solenoid valve.

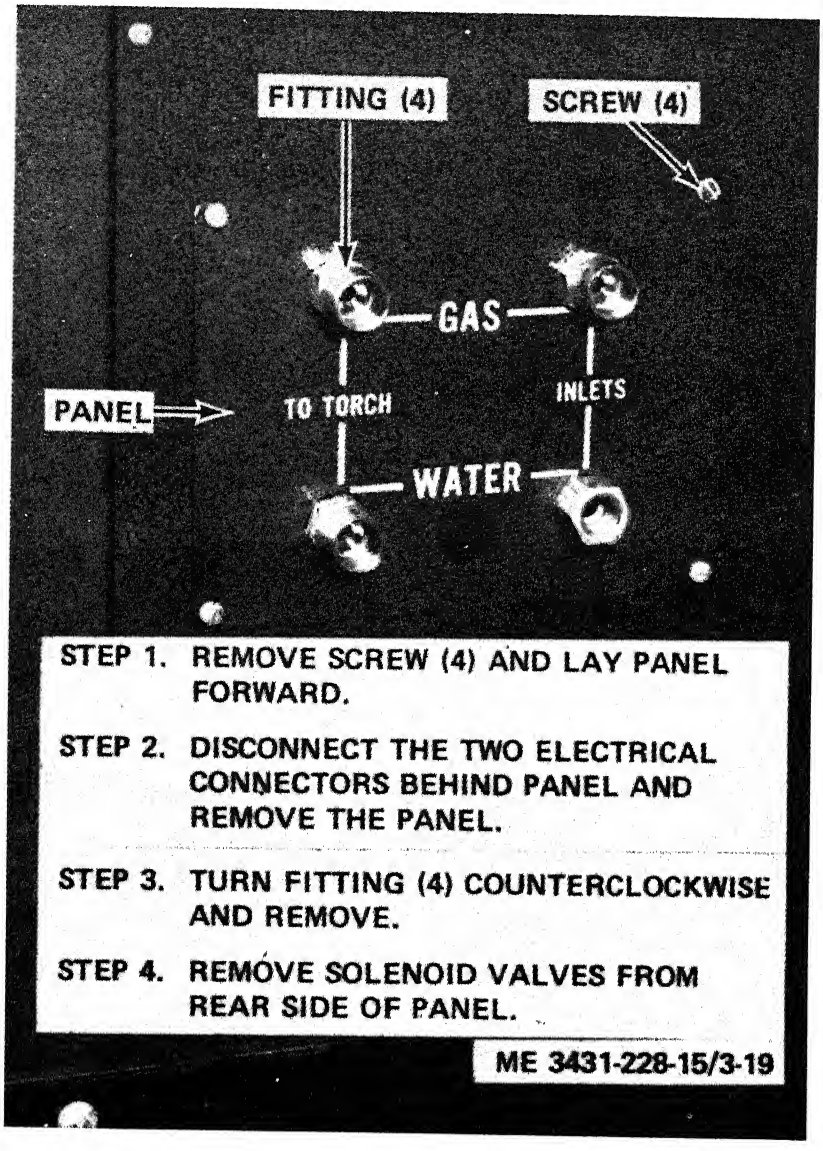


Figure 3-19. Solenoid valves, removal and installation.

3-35. Voltage Change Board

a. Removal.

(1) Disconnect ac power from the welding machine.

(2) Remove top and housing (para 3-20).

(3) Refer to figure 3-20 and remove the voltage change board.

b. Installation.

(1) Refer to figure 3-20 and install the voltage change board.

(2) Install the top and housing (para 3-20).

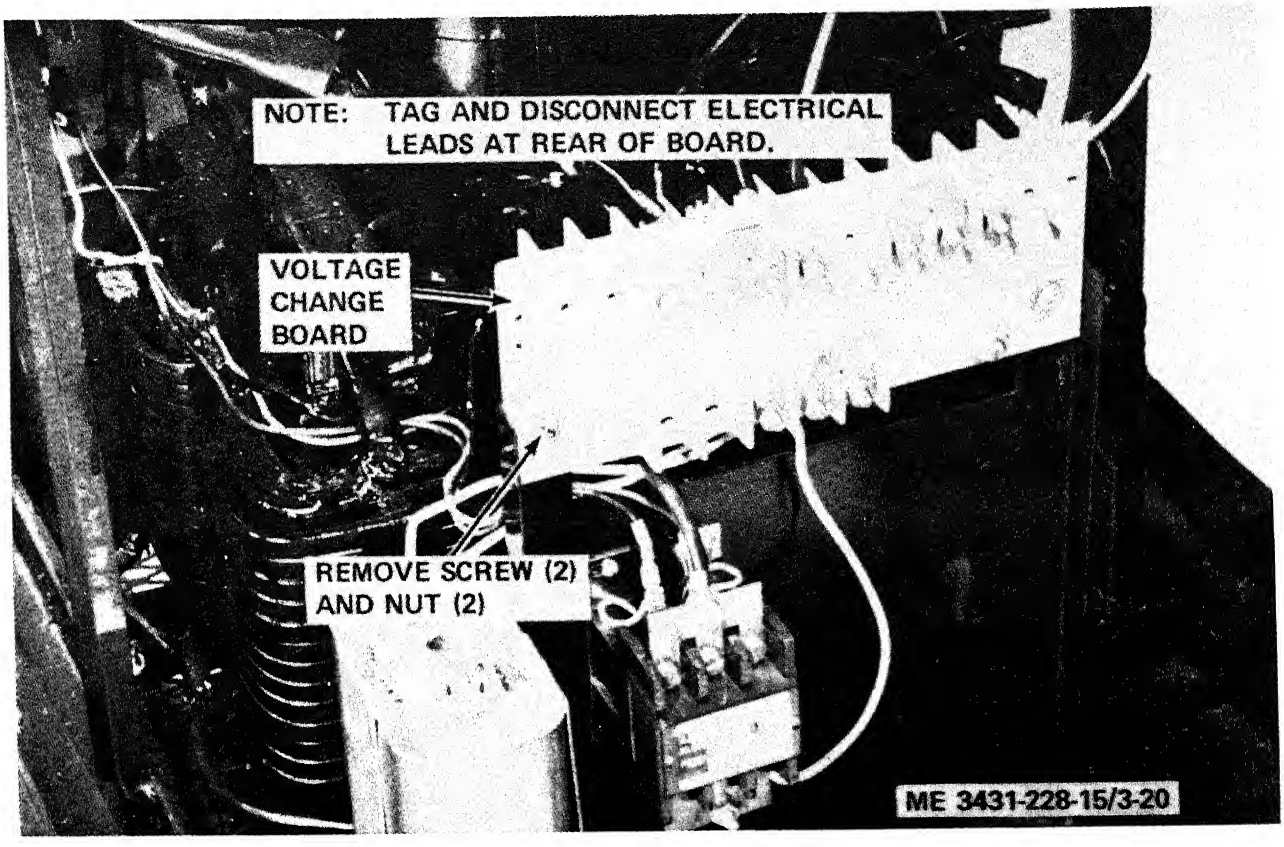


Figure 3-20. Voltage change board, removal and installation.

3-36. Fan Motor and Guard Assembly

a. General. The fan guard, blade, shroud, and ballast resistors RT1 and RT2 are all mounted together in an assembly. The assembly is secured to the rear panel of the housing by four screws.

b. Removal of Assembly.

(1) Disconnect ac power from the welding machine.

(2) Remove the welding machine top and housing (para 3-20). Rear panel may be left attached to base if desired.

(3) Refer to figure 3-21 and remove the assembly.

c. Installation of Assembly.

(1) Refer to figure 3-21 and install the assembly.

(2) Install the top and housing (para 3-20).

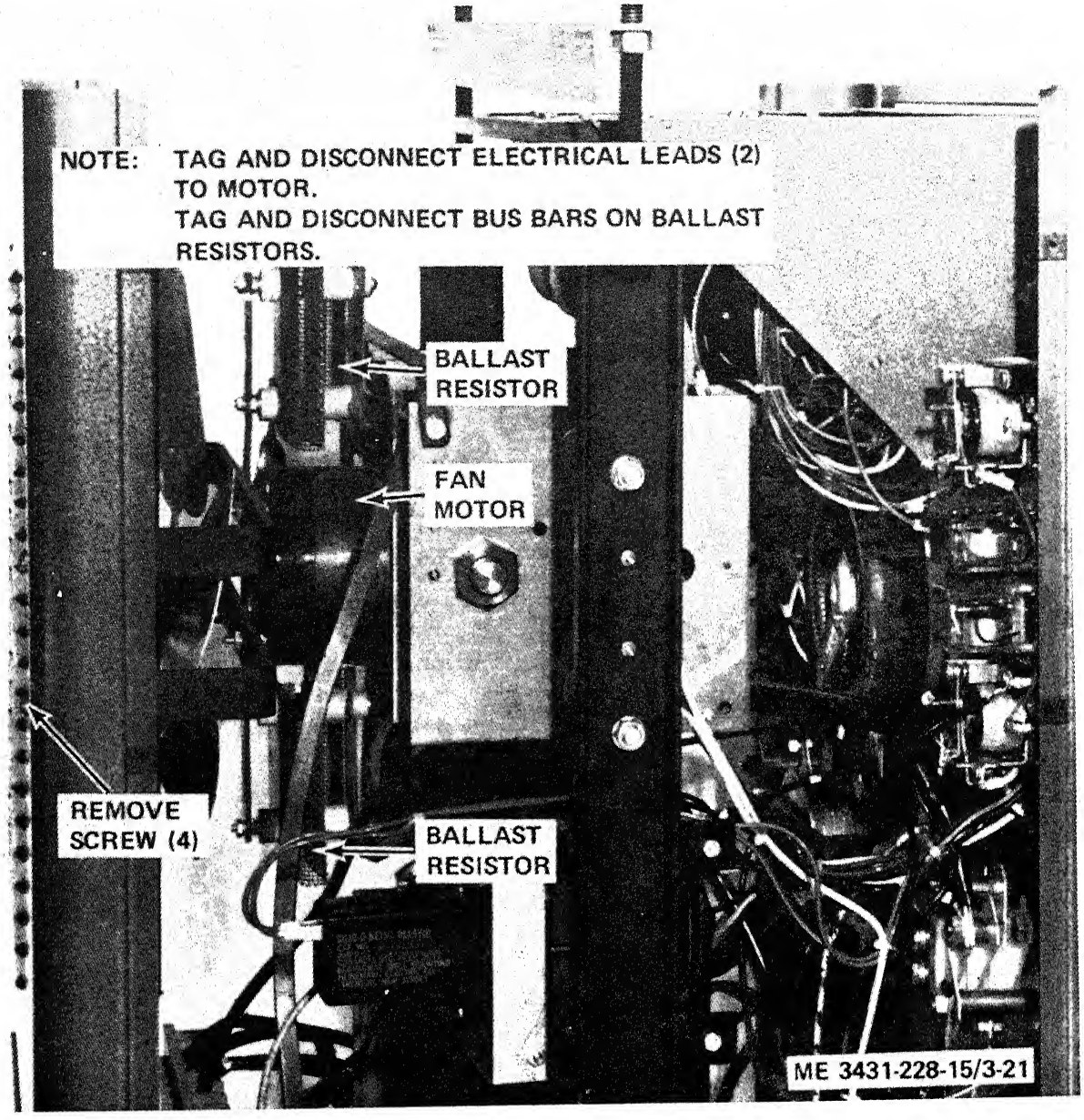


Figure 3-21. Fan motor and guard assembly, removal and installation.

3-37. Fan Blade, Motor, and Ballast Resistors

a. Removal.

(1) Remove the fan motor and guard assembly (para 3-36).

(2) Refer to figure 3-22 and remove the fan blade, the motor, and the ballast resistors.

b. Installation.

(1) Refer to figure 3-22 and install the fan blade, motor, and ballast resistors.

(2) Install the fan motor and guard assembly (para 3-36).

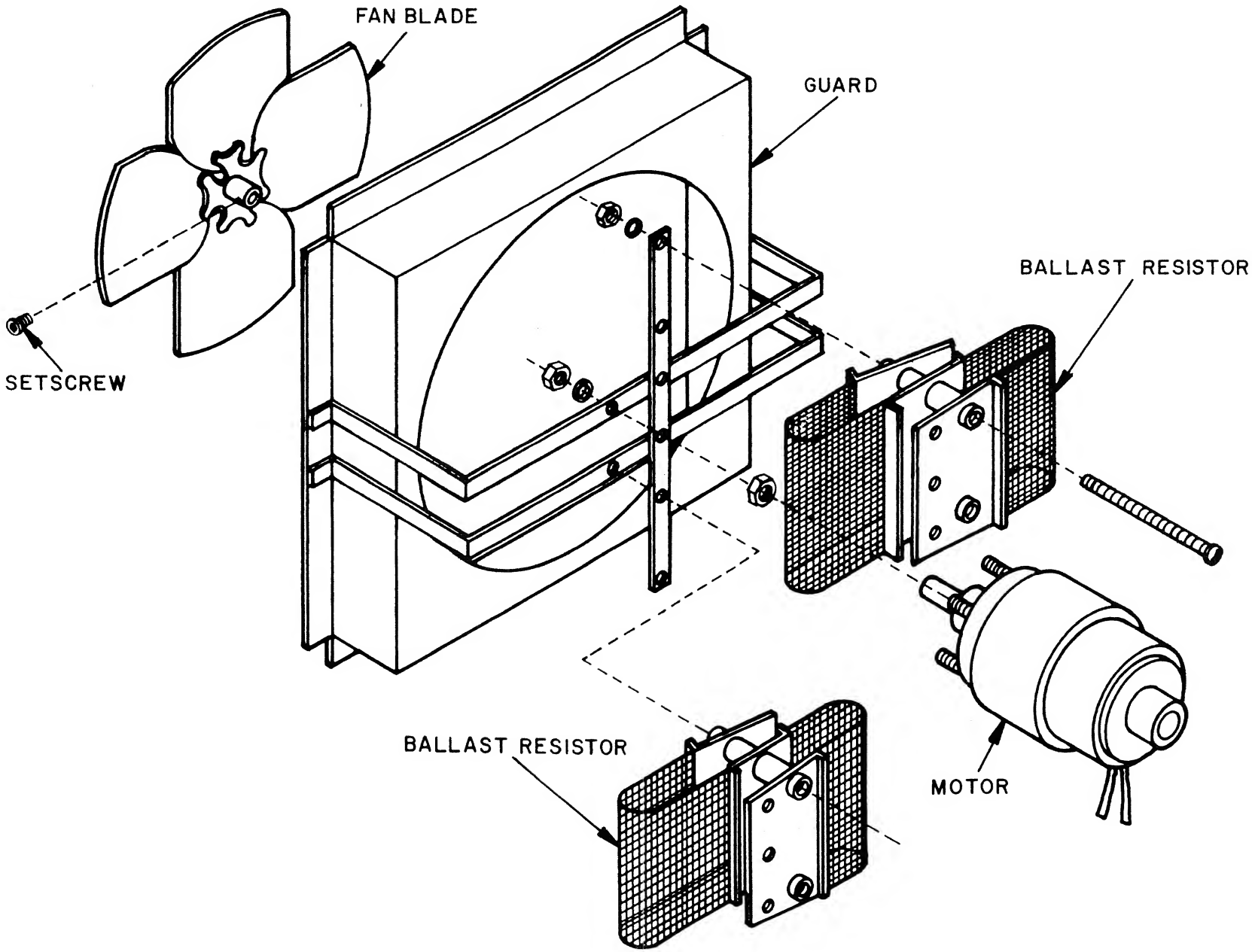


Figure 3-22. Fan blade, motor, and ballast resistors, removal and installation.

ME 3431-228-15/3-22

CHAPTER 4
MATERIAL USED IN CONJUNCTION WITH MAJOR ITEM

4-1. General

This chapter describes accessories, components, and attachments used in conjunction with the welding machine.

4-2. Remote Foot Control

a. General. This accessory permits the operator to operate the contactor and to vary welding current with a foot control which may be located at the welding table. The foot control is attached to a cable, which plugs into the REMOTE RECEPTACLE on the front panel of the welding machine. The foot control contains a switch and a rheostat. Figure 4-1 is the schematic diagram for troubleshooting or checking when required. The connector terminals are identified on this illustration. For application in the welding machine, refer to the overall schematic diagram of the welding machine (fig. 7-2).

b. Disassembly. Refer to figure 4-2 to disassemble the remote foot control case. Remove the four screws and lift off the bottom of the case.

c. Removing Switch. Refer to figure 4-3 and remove the microswitch.

d. Installing Switch. Refer to figure 4-3 and install the microswitch.

e. Removing Rheostat. Refer to figure 4-3 and remove the rheostat.

f. Installing Rheostat. Refer to figure 4-3 and install the rheostat.

g. Reassembly. Refer to figure 4-2 and reassemble the foot control.

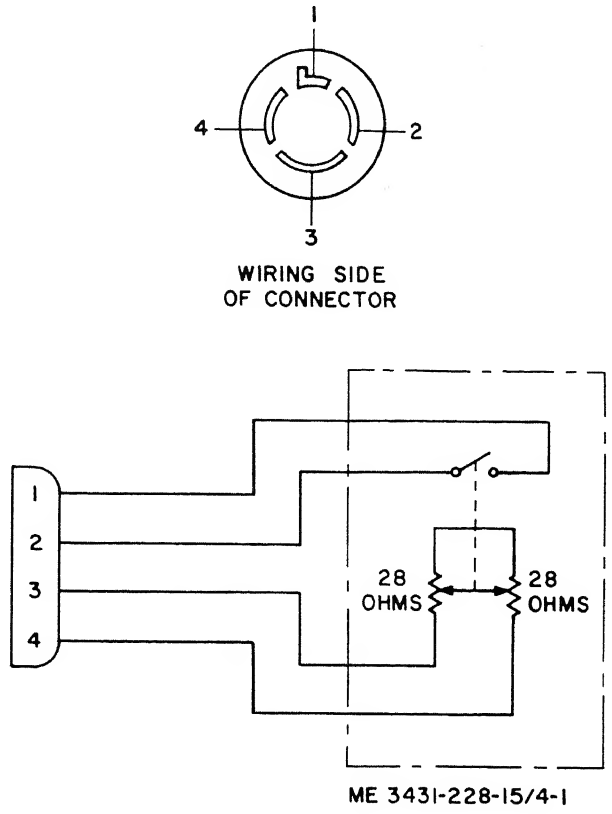


Figure 4-1. Remote foot control schematic.

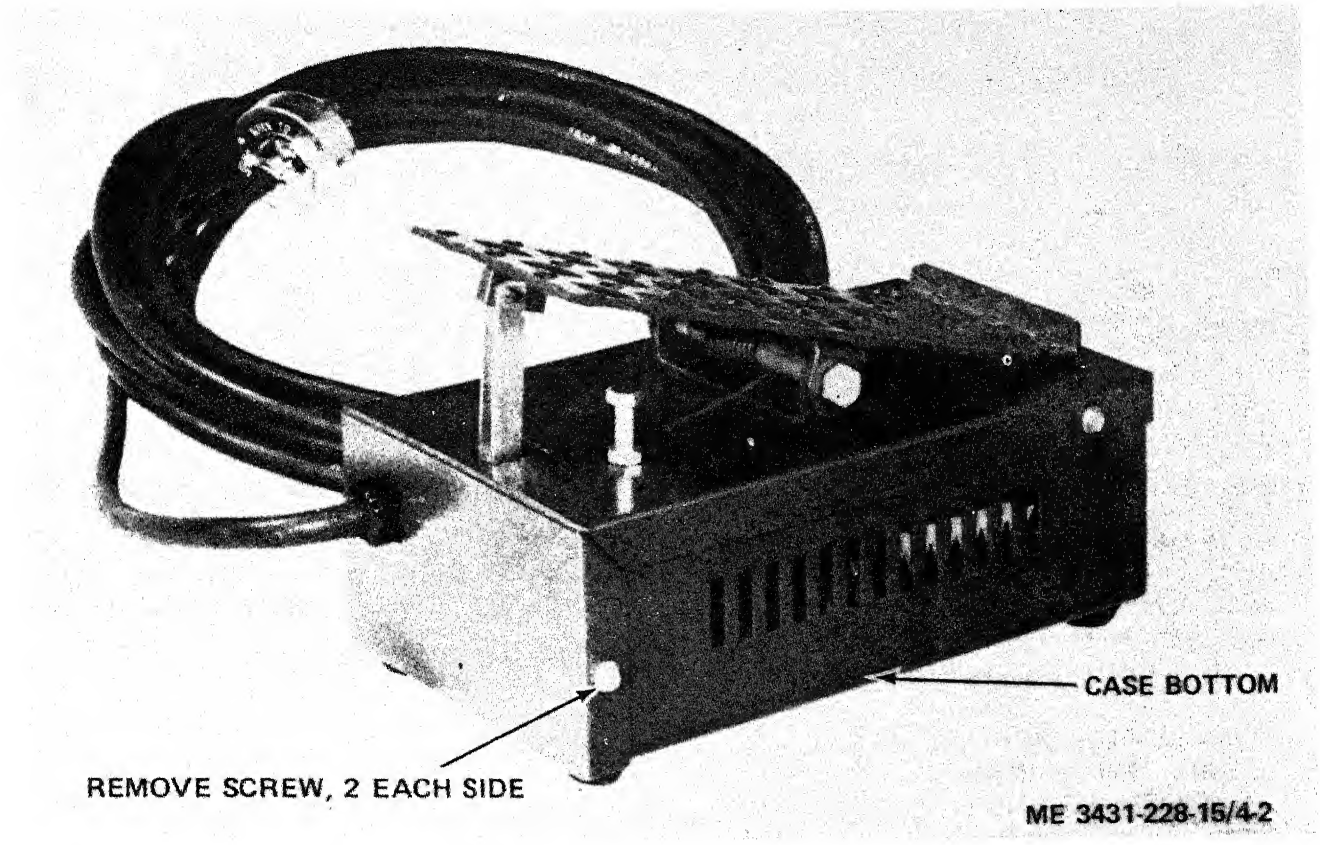


Figure 4-2. Remote foot control, disassembly.

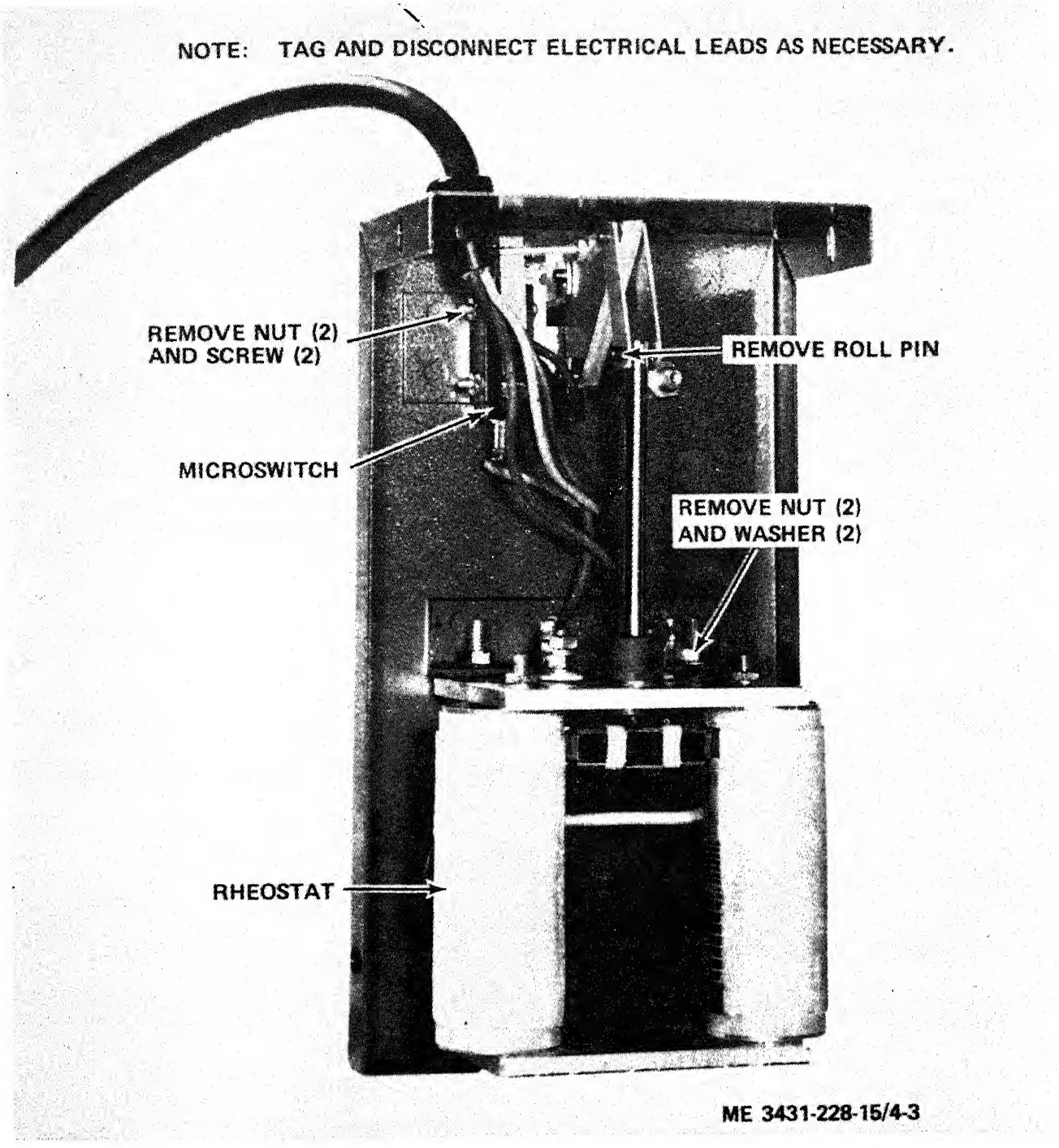


Figure 4-3. Switch and rheostat, removal and installation.

4-3. Pipe Nipple and Strainer

A ¼ inch brass pipe nipple and a strainer are supplied for the water inlet to the welding machine when required. Screw the pipe nipple into the female water inlet fitting (fig. 2-2). Screw the strainer onto the other end of the nipple. Then connect the water, using a ¼ inch pipe, into the ¼ inch female fitting on the strainer.

CHAPTER 5
SHIPMENT AND LIMITED STORAGE AND DEMOLITION TO PREVENT ENEMY USE

Section I. SHIPMENT AND LIMITED STORAGE

5-1. Preparation of Equipment for Shipment

a. General. Detailed instructions for the preparation of engineer equipment for domestic shipment are outlined below. Preservation will be accomplished in sequence that will not require the operation of previously preserved components.

b. Inspection. The welding machine will be inspected for any unusual conditions such as damage, rusting, accumulation of water, and pilferage. Inspection of the individual components and assemblies will be as outlined on the "Preventive Maintenance Service, Quarterly" in this manual.

c. Cleaning and Drying. Clean all surfaces with an approved cleaning solvent and dry thoroughly. Refer to TM 38-230 for choice and application of cleaning method.

d. Painting. Paint all surfaces on which the paint has been removed or damaged. Refer to TM 9-213 for detailed cleaning and painting instructions.

e. Depreservation Guide. DA Form 2258 Depreservation Guide of Engineer Equipment.

(1) A properly annotated depreservation guide will be completed concurrently with preservation for each item of mechanical equipment with all peculiar requirements outlined in the remarks column. The complete depreservation guide will be placed with the equipment in a waterproof envelope, marked "Depreservation Guide," and fastened in a conspicuous location on or near the operator's controls.

(2) Prior to placing equipment in operation or to the extent necessary for inspection depreservation of the item will be preformed as outlined on the depreservation guide.

f. Sealing of Openings. The fan guard opening located in the back panel of the welding machine will be covered with waterproof paper and sealed with type III, Class I, pressure sensitive tape conforming to Specification PPP-T-60.

g. Marking. Will conform to MIL-STD-129.

h. Disassembly, Disassembled Parts, and Basic Issue Items.

(1) Disassembly will be limited to the removal of parts and projecting components that tend to increase the overall profile of the equipment and that which is subject to pilferage.

(2) Disassembled items will be packed with the publications in the toolbox if possible. Otherwise, items will be packed in a suitable container and secured to the equipment to prevent loss or pilferage.

Note. If packaging is required to provide adequate protection against damage during shipment, refer to TM 38-230 for guidance in crate fabrication.

5-2. Loading Equipment for Shipment

a. Loading.

(1) Be sure the packing crate remains right side up when removing the welding machine to the loading site.

(2) The welding machine can be loaded with either a forklift or crane.

***Warning:* When using a lifting device to move the welding machine, make sure that it has a safe lifting capacity of at least 1,000 pounds. Do not allow the welding machine to swing freely when being lifted. Failure to observe this warning may cause damage to the equipment or serious injury to personnel.**

b. Shipping. Block or tie welding machine right side up to the bed of the carrier to prevent shifting while being transported.

5-3. Preparation of Equipment for Storage

a. Detailed Instructions for preparation of the welding machine for limited storage are provided in paragraph 5-4*b*. Limited storage is defined as storage not to exceed six (6) months. Refer to TM 740-90-1 (Administrative Storage of Equipment).

b. Every Effort Should be made to provide covered storage for the welding machine. If this is impossible, select a firm, level, well-drained storage location, protected from prevailing winds. Position the welding machine on heavy planking. Cover the welding machine with a tarpaulin or other suitable waterproof covering and secure in a manner that will provide the welding machine maximum protection from the elements.

5-4. Inspection and Maintenance of Equipment in Storage

a. Inspection. When the welding machine has been

placed in storage, all scheduled preventive maintenance services, including inspection, will be suspended and preventive maintenance inspection will be performed as specified herein.

b. Worksheet and Preventive Maintenance. DA Form 2404 will be executed on the welding machine when the equipment is initially placed in storage, and every 30 days thereafter. F maintenance will be performed promptly t that the welding machine is mechanically so ready for immediate use.

Section II. DEMOLITION OF MATERIAL TO PREVENT ENEMY USE

5-5. General

When capture or abandonment of the welding machine to an enemy is imminent, the responsible unit commander must make the decision either to destroy the equipment or to render it inoperative. Based on this decision, orders are issued which cove sired extent of destruction. Whatever m demolition is employed, it is essential to de same vital parts of all welding machines corresponding repair parts. Refer to TM 750-

CHAPTER 6
DIRECT SUPPORT, GENERAL SUPPORT, MAINTENANCE INSTRUCTIONS

Section I. GENERAL

6-1. Scope

This chapter contains information for direct support (DS) and general support (GS) level maintenance. Troubleshooting, removal and replacement, and repair are described. Refer to previous chapters for information describing operator and organizational level maintenance.

6-2. Forms and Records

DA Forms and records used for equipment maintenance will be only those prescribed in TM 38-750.

Section II. DESCRIPTION AND DATA

6-3. Description

For a complete description of functional circuits in the welding machine, refer to paragraph 3-20 through 3-23.

6-4. Tabulated Data

a. General. This paragraph contains data pertinent to overhaul and repair at DS and GS maintenance.

b. Control Transformer T2.

Primary	230 or 460 vac
Frequency	60 Hertz
Secondary	230 vac and 24 vac

c. Nut and Bolt Torque Data.

Diodes	20 to 25 ft-lb

d. Schematic Wiring Diagram. Figure 7-2 shows the schematic wiring diagram for this welding machine.

e. Time Standards. Table 6-1 lists the number of man-hours required under normal conditions to perform the indicated maintenance and repair for the model MD301 FED Inert Gas Shielded Arc Welding Machine. Components are listed under the appropriate index. The times listed are not intended to be rigid standards. Under adverse conditions, the operations will take longer, but under ideal conditions with highly skilled mechanics, most of the operations can be accomplished in considerably less time.

Table 6-1. Time Standards

	Remove and replace	Man-hours
01	HOUSING AND FRAME SUPPORT	
	Lifting eye	0.2
	Cover, top	0.3
	Panels, housing	0.5
02	VENTILATING SYSTEM	
	Motor, fan	1.3
	Guard assembly, fan, (incl. motor)	1.4
	Blade, fan	1.0
03	CONTROL PANELS	
	Front Panel	
	Switch, contactor	0.5
	Switch, amperage	0.5
	Switch, soft start	1.0
	Switch, range	1.0
	Switch, polarity	0.7
	Rheostat, weld amperes control	0.8
	Receptacle, remote	0.7
	Timer and High Frequency Drawer	
	Spark gap assembly	1.4
	Switches; power, gas-water, high frequency	0.5
	Switches; spot arc, and high frequency dropout	0.5
	Capacitor	0.5
	Rheostat, intensity	0.5
	Relays, Plug-in	0.4
	Transformer, high frequency	1.0
	Lights; power, gas-water and high frequency	0.4
04	CONNECTING DEVICES	
	Voltage change bar	0.2
	Terminal board	1.5
	Wiring harness assembly	5.0
	Cables, ground and electrode	0.2

Table 6-1. Time Standards — Continuted

	Remove and replace	Man-hours
	Holder, electrode	0.4
	Clamp, ground	0.4
05	PROTECTIVE DEVICES	
	Switch, thermostatic	0.6
	Fuse	0.1
	Fuseholder	1.0
06	RECTIFIER COMPONENTS	
	Rectifier, main power	1.5
	rectifier, control	1.0
07	TRANSFORMER COMPONENTS	
	Transformer, main, includes complete disassembly of unit	8.0
	Transformer, control	2.6
	Coil, tesla	1.0
	Reactor, filter	2.0
08	SWITCHING, TIMING, AND SPEED CONTROL	
	Timers, plug-in	0.4
	Relay, soft start power	
	Relay, soft start delay	
	Relay, soft start preset	
	Relay, pilot	
	Contractor, main	
	Valve, solenoid	
	Capacitor, filter	
	Capacitor, power factor	
09	RESISTORS	
	Resistors, filter	
	Resistors, ballast	
10	CONTROL ASSEMBLY, REMOTE FOOT	
	Switch	
	Rheostat	
11	DATA PLATES	
	Plate, identification	
	Plates, caution and instruction	

Section III. REPAIR PARTS, SPECIAL TOOLS, AND EQUIPMENT

6-5. Special Tools and Equipment

Maintenance of the welding machine at the DS and GS maintenance level requires no special tools or equipment.

6-6. Direct Support, General Support Maintenance

Direct and general support maintenance re are listed and illustrated in TM 5-3-228-35P.

6-7. Specially Designed Tools an ment

No specially designed tools or equipme quired.

Section IV. TROUBLESHOOTING

6-8. General

This section contains information for the diagnosis and correction of unsatisfactory operation or failure of the welding machine. Typical malfunctions which may occur are listed in table 6-2. Each malfunction stated is followed by a list of probable causes for each trouble. Te corrective action recommended is described opposite the probable cause. Refer to table 3-2 for organizational level troubleshooting.

6-9. Sensory Inspection

Warning: **Ballast resistors (on fan assembly) get extremely hot when welding on ac.**

a. Before making checks or replacin remedy troubles, make a sensory inspect nect main power and look for smoking, charred wires and items. Look for brok wires. Touch suspected parts except bal for signs of overheating.

b. Burning or overheating items fre duce characteristic odors. Attempt to small, the source of unusual odors comi welding machine.

Table 6-2. Direct Support and General Support Troubleshooting.

Item no.	Malfunction	Probable cause	Corrective action
1	Welding machine fails to start, and POWER lamp does not light.	*a.* Defective control transformer T2. *b.* Defective wiring.	*a.* Replace transformer. (para 6-18) *b.* Check wiring for loose connections or broken wires. Make continuity tests with power off. Repair wiring as required.
2	Welding machine operates erratically.	*a.* Defective diodes. *b.* Defective WELD AMPERES control rheostat R1. *c.* Loss of control circuit. *d.* Defective RANGE SWITCH or POLARITY SWITCH contacts.	*a.* Check diodes (para 6-10) and replace if required. Measure open circuit voltages. If it is low (10 volts), diode is shorted. *b.* Measure resistance of the 32 ohm rheostat. Replace if defective. (para 6-15). *c.* Check control rectifier CR2. Replace if defective (para 6-22). *d.* Check for dirty, greasy or bent contacts and clean or repair as required. Replace switch if not repairable. (para 6-14).
3	Contactor K8 releases and disconnects power.	*a.* Welding machine overheating. *b.* Overload relay K7 operated. *c.* Defective power relay K5, relay K6, or timer M2 and M4.	*a.* Check for stopped fan motor or shorts producing excessive heat. *b.* Check for shorted wiring causing excessive current from T1. Also check for shorted transformer winding. Repair or replace as necessary. (para 6-17). *c.* Check and replace as required. (para 3-31, 6-29).
4	High-frequency does not appear at output.	*a.* Defective transformer T3. *b.* Spark gap misadjusted. *c.* Capacitor C9 open. *d.* Open wiring or banana plug loose.	*a.* Replace. (para 6-19). *b.* Check the contacts and clean and readjust as necessary (para 3-29). *c.* Connect ohmmeter across C9. If it does not indicate initial charge, replace. (para 6-28). *d.* Make continuity check. Repair as required. (para 6-27).
5	Polarity cannot be selected	POLARITY SWITCH is defective	Check and replace if defective (para 6-14).
6	Range cannot be selected	RANGE SWITCH is defective	Check and replace if defective. (para 6-14).
7	Welding machine has internal arcing	*a.* Connections loose *b.* Shorted coils	*a.* Tighten connections *b.* Check and replace if defective
8	Welding machine smokes	*a.* Main transformer defective *b.* Control transformer defective	*a.* Check and replace if defective. (Para 6-17). *b.* Check and replace if defective. (para 6-18).
9	High frequency will not drop out after arc starts	Defective pilot relay K1 or associated circuit	Check and replace if defective. (para 6-22).
10	WELD AMPERES control does not affect current in each range. Output is the minimum value of the range setting.	*a.* Defective control rectifier CR2 *b.* Defective WELD AMPERES rheostat R1	*a.* Check and replace if defective. (para 6-22). *b.* Check and replace if defective. (para 6-15).
11	Arc will not start when POLARITY SWITCH is set on DC. POWER light is illuminated.	Silicon diodes in main rectifier shorted	Check diodes and replace if defective. (para 6-10, 6-26).

6-10. Checking Diodes

Note. The pig-tails must be opened first or you can get a false reading.

The silicon diodes, CR4 through CR7, can be quickly checked with an ohmmeter. Disconnect the pig-tail lead and measure the resistance across the diode, with the ohmmeter set for a low resistance range. Then reverse the ohmmeter leads and measure the resistance again in the other direction. The two resistance readings should be considerably different. When the ohmmeter battery is reverse biasing the diode, the resistance reading is much higher. If the two resistance readings are nearly the same or zero, the diode is defective.

6-11. Checking Wiring Continuity

Check for broken or loose wires using an ohmmeter. Set the ohmmeter to the lowest resistance scale and make point-to-point measurements which should read zero ohms. Refer to the schematic diagram for locating common electrical points. (fig. 7-2).

Section V. REMOVAL AND INSTALLATION OF MAJOR COMPONENTS AND AUXILIARIES

6-12. Scope

This section contains procedures for removing and replacing items requiring DS and GS level maintenance.

6-13. Front Control Panel

a. Removal. This procedure describes the steps necessary to remove the front control panel and all the parts mounted on it. Proceed as follows.

(1) Disconnect ac power from the welding machine.

(2) Remove the timer and high frequency drawer (para 3-19).

(3) Remove the top and housing. (para 3-20).

(4) Remove the RANGE SWITCH (para 6-14).

(5) Remove the POLARITY SWITCH (para 6-14).

(6) Remove the REMOTE RECEPTACLE (para 3-26).

(7) Remove the CONTACTOR switch AMPERAGE switch (para 3-27).

(8) Refer to figure 6-1 and remove the fr trol panel.

b. Installation.

(1) Refer to figure 6-1 and remove the f trol panel.

(2) Install the CONTACTOR switch AMPERAGE switch (para 3-27).

(3) Install the REMOTE RECEPTACI 3-26).

(4) Install the RANGE SWITCH and LARITY SWITCH (para 6-14).

(5) Install the top and housing (para 3-20

(6) Install the timer and high frequenc (para 3-19).

Figure 6-1. Front control panel, removal and installation.

6-14. RANGE SWITCH and POLARITY SWITCH

a. Removal. To remove the RANGE SWITCH and POLARITY SWITCH, proceed as follows.

(1) Disconnect ac power from the welding machine.

(2) Remove the timer and high frequency drawer (para 3-19).

(3) Remove the top and housing from the welding machine (para 3-20).

(4) Remove the screws around the bottom edge of the front panel to permit movement of the panel.

(5) Refer to figure 6-2 and remove the switches from the rear of the panel.

b. Installation.

(1) Refer to figure 6-2 and install the switches.

(2) Install the screws around the bottom edge of the front panel.

(3) Install the top and housing (para 3-20).

(4) Install the timer and high frequency drawer (para 3-19).

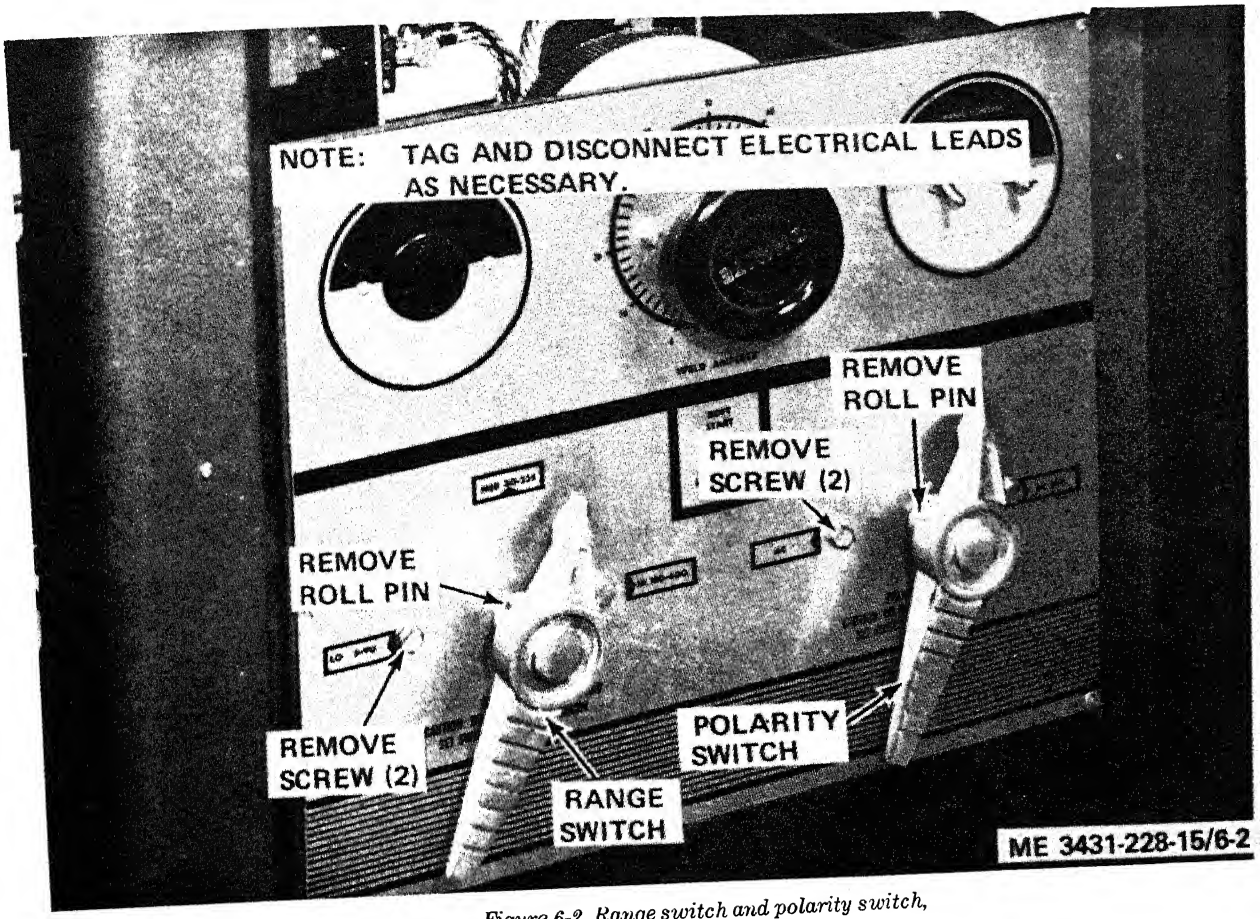


Figure 6-2. Range switch and polarity switch, removal and installation.

6-15. WELD AMPERES Control Rheostat R1

a. Removal. Proceed as follows to remove the WELD AMPERES control rheostat.

(1) Disconnect ac power from the welding machine.

(2) Remove the timer and high frequency drawer (para 3-19).

(3) Remove the top and housing from the welding machine (para 3-20).

(4) Refer to figure 6-3 and remove the WELD AMPERES control rheostat from the rear of the panel.

b. Testing.

(1) Connect an ohmmeter to the two outer terminals of the control and set the meter on RX1 scale. The reading should be 32 ohms. If the reading is more than 35 or less than 29 ohms, replace the control.

(2) Connect an ohmmeter to the center terminal and either outside terminal of the control. Set the meter on the RX1 scale. Turn the control in either direction until it stops, then turn it in the opposite direction slowly and evenly until it stops again. The indicator on the meter should increase or decrease evenly according to the speed in which the control is turned. If the meter indicator does not function as described, replace the control.

c. Installation.

(1) Refer to figure 6-3 and install the WELD AMPERES control rheostat.

(2) Install the screws along the bottom edge of the front panel.

(3) Install the top and housing (para 3-20).

(4) Install the timer and high frequency drawer (para 3-19).

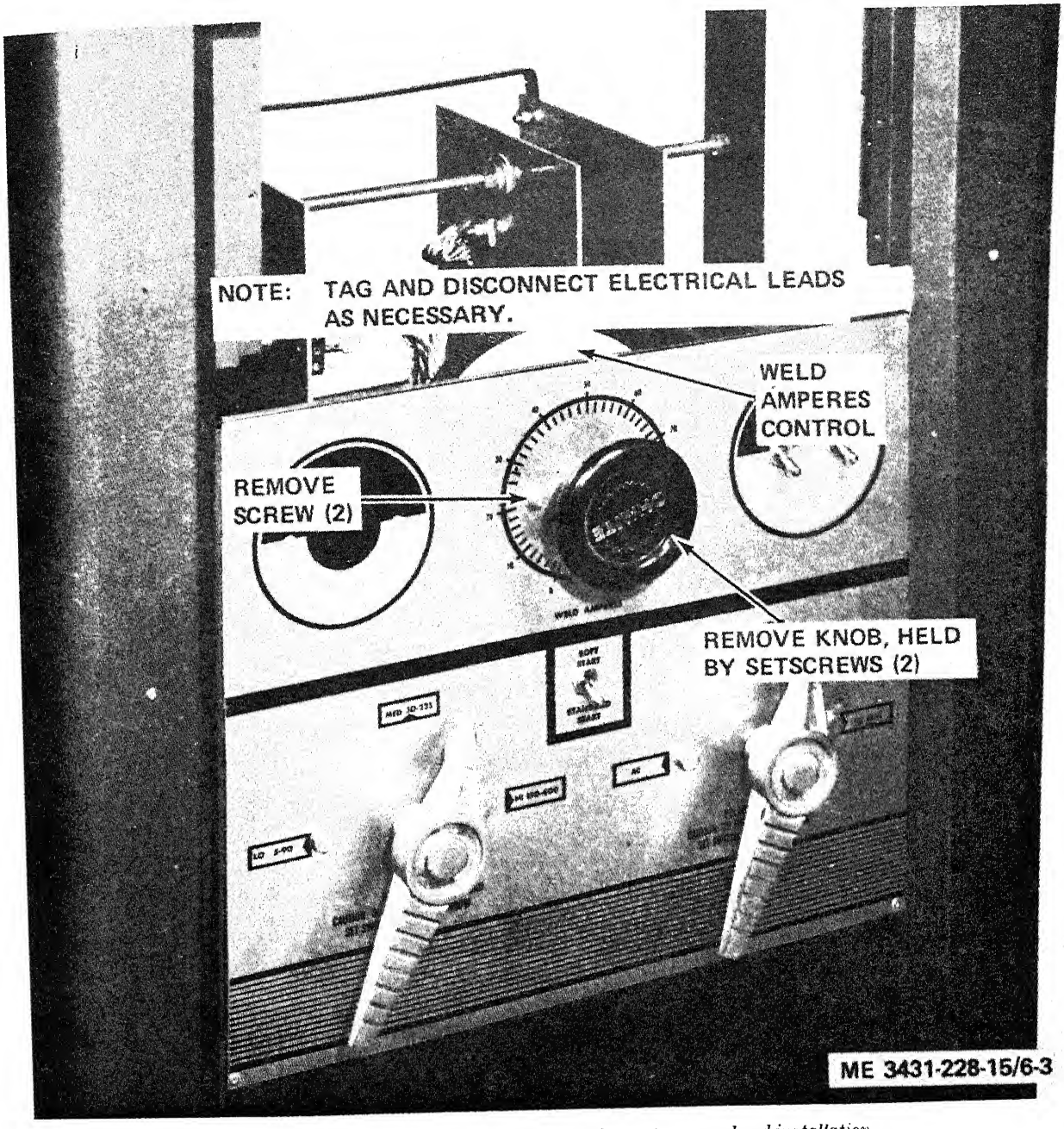


Figure 6-3. Weld amperes control rheostat, removal and installation.

6-16. HIGH FREQUENCY START intensity Control Rheostat R5

a. Removal. Proceed as follows to remove the HIGH FREQUENCY START intensity control rheostat.

(1) Disconnect ac power from the welding machine.

(2) Unlock and open the door on the front of the timer and high frequency drawer.

(3) Refer to figure 6-4 and remove the rheostat.

b. Testing.

(1) Connect an ohmmeter to the outside terminals of the control, and set the meter on the RX1 scale. The reading should be 2 ohms. If the reading is more or less than 2 ohms replace the intensity control rheostat.

(2) Connect the ohmeter to the center terminal and either outside terminal. Set the meter on the RX1 scale. Turn the intensity control in a clockwise direction until it stops; the meter should have a zero reading. Then turn the intensity control in a counterclockwise direction until it stops. The reading should be 2 ohms. If the readings are not as described, replace the intensity control rheostat.

c. Installation.

(1) Refer to figure 6-4 and install the rheostat.

(2) Close and lock the timer and high frequency drawer.

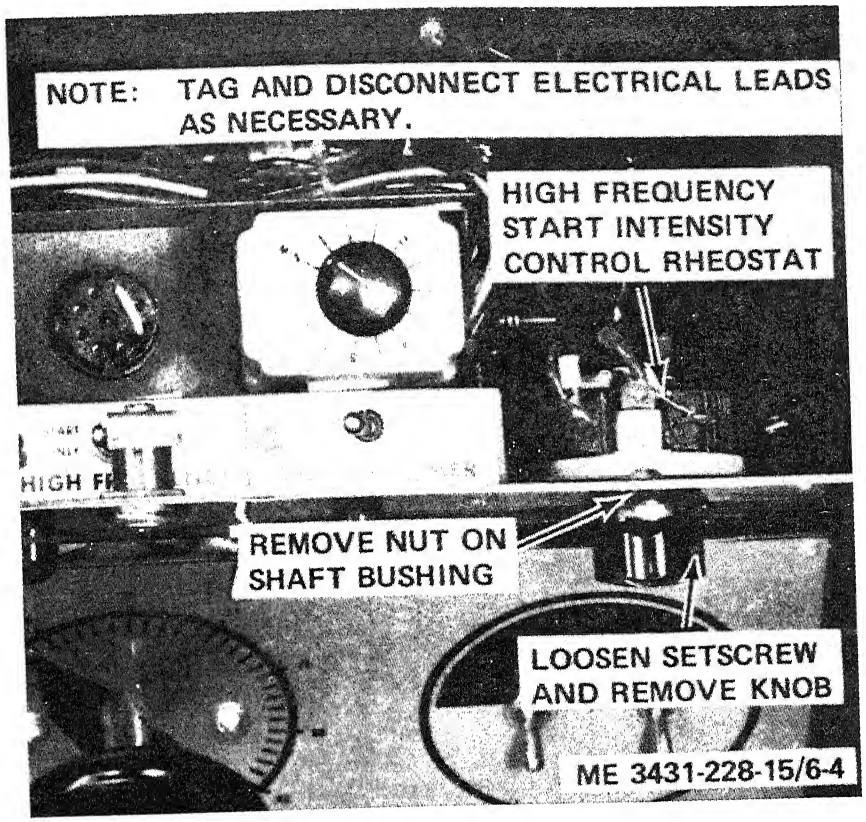


Figure 6-4. High frequency start intensity control rheostat, removal and installation.

6-17. Main Transformer T1

a. Removal. This transformer is extremely heavy and difficult to remove. Eliminate all other possible sources of trouble before removal. Filter reactor L1 is mounted on top of the transformer. Proceed as follows to remove the transformer.

(1) Disconnect ac power from the welding machine.

(2) Remove the timer and high frequency drawer (para 3-19).

(3) Remove the top and housing from the welding machine (para 3-20).

(4) Remove the fan motor and guard assembly (para 3-36).

(5) Remove the front control panel (para 6-13).

(6) Remove the power rectifier assembly suspended above the transformer (para 6-26).

(7) Remove the tesla coil (para 6-20).

(8) Remove overload relay K7 and control transformer T2 (para 6-18).

(9) Remove filter reactor L1 (para 6-21).

***Warning:* The main transformer weighs approximately 300 pounds.**

(10) Refer to figure 6-5 and use proper material handling equipment to remove the main transformer from the base.

b. Installation.

(1) Refer to figure 6-5 and install the main transformer on the base assembly.

(2) Install filter reactor L1 (para 6-21).

(3) Install overload relay K7 and control transformer T2 (para 6-18).

(4) Install tesla coil (para 6-20).

(5) Install power rectifier assembly (para 6-26).

(6) Install front control panel (para 6-13).

(7) Install fan motor and guard assembly (para 3-36).

(8) Install top and housing (para 3-20).

(9) Install the timer and high frequency drawer (para 3-19).

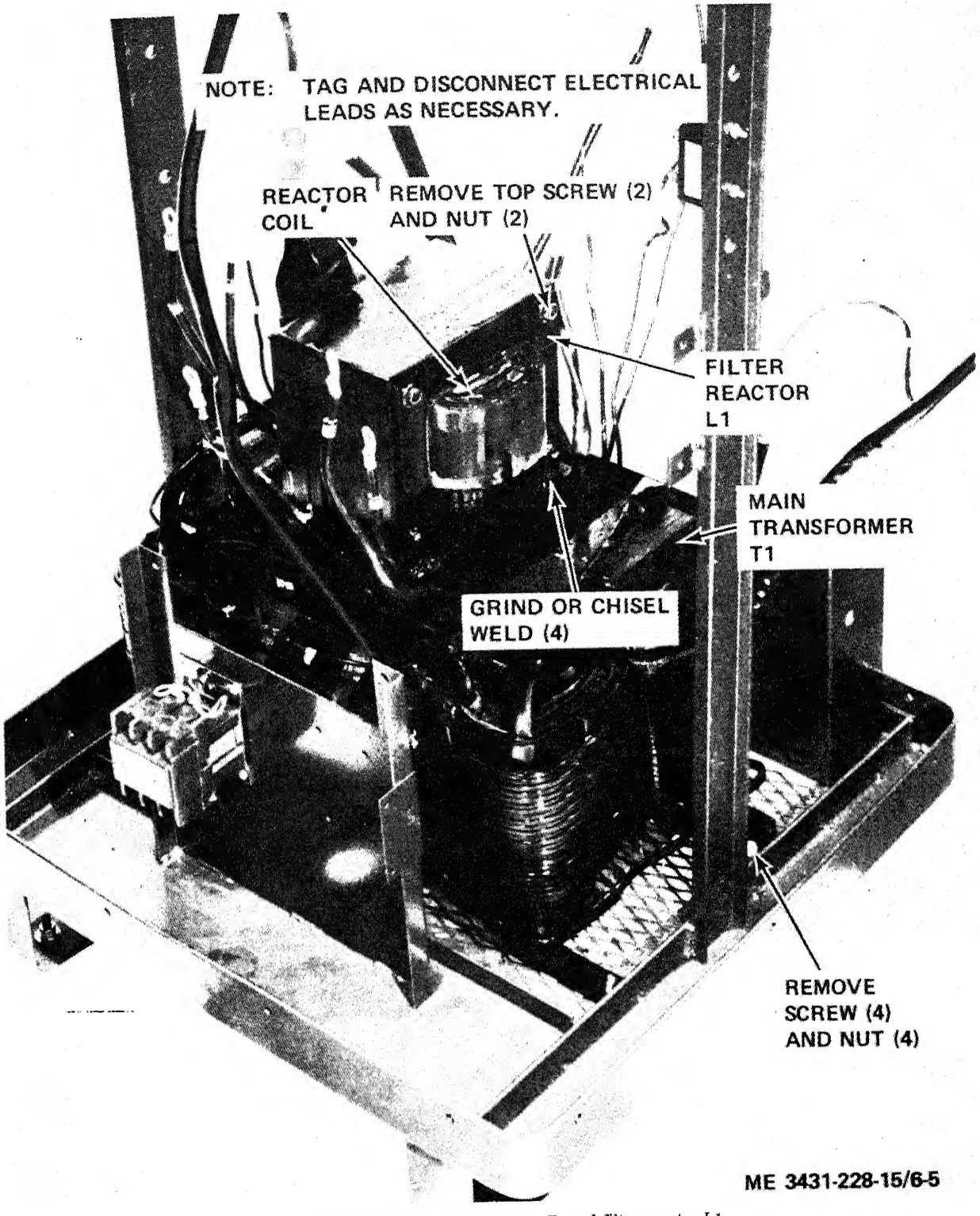


Figure 6-5. Main transformer T1 and filter reactor L1, removal and installation.

6-18. Overload Relay K7 and Control Transformer T2

a. Removal.

(1) Disconnect ac power from the welding machine.

(2) Remove the top and housing (para 3-20).

(3) Refer to figure 6-6 and remove overload relay K7.

(4) Refer to figure 6-6 and remove control transformer T2.

b. Installation.

(1) Refer to figure 6-6 and install the control transformer.

(2) Refer to figure 6-6 and install the overload relay.

(3) Install the top and housing (para 3-20).

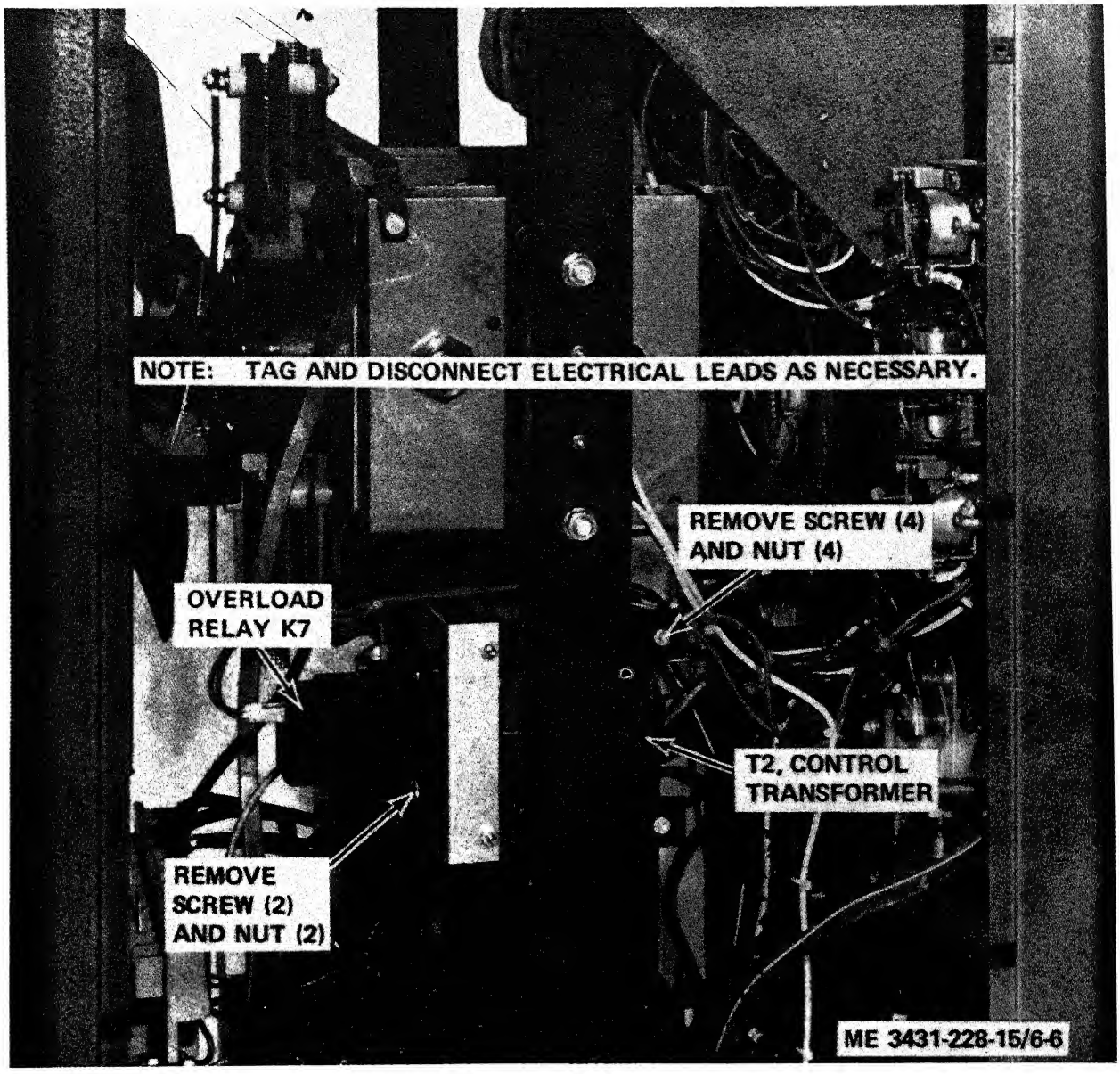


Figure 6-6. Overload relay K7 and control transformer T2, removal and installation.

6-19. High Frequency Transformer T3

a. Removal.

(1) Remove timer and high frequency drawer (para 3-19).

(2) Refer to figure 6-7 and remove the high frequency transformer.

b. Installation.

(1) Refer to figure 6-7 and install the high frequency transformer.

(2) Install the timer and high frequency drawer (para 3-19).

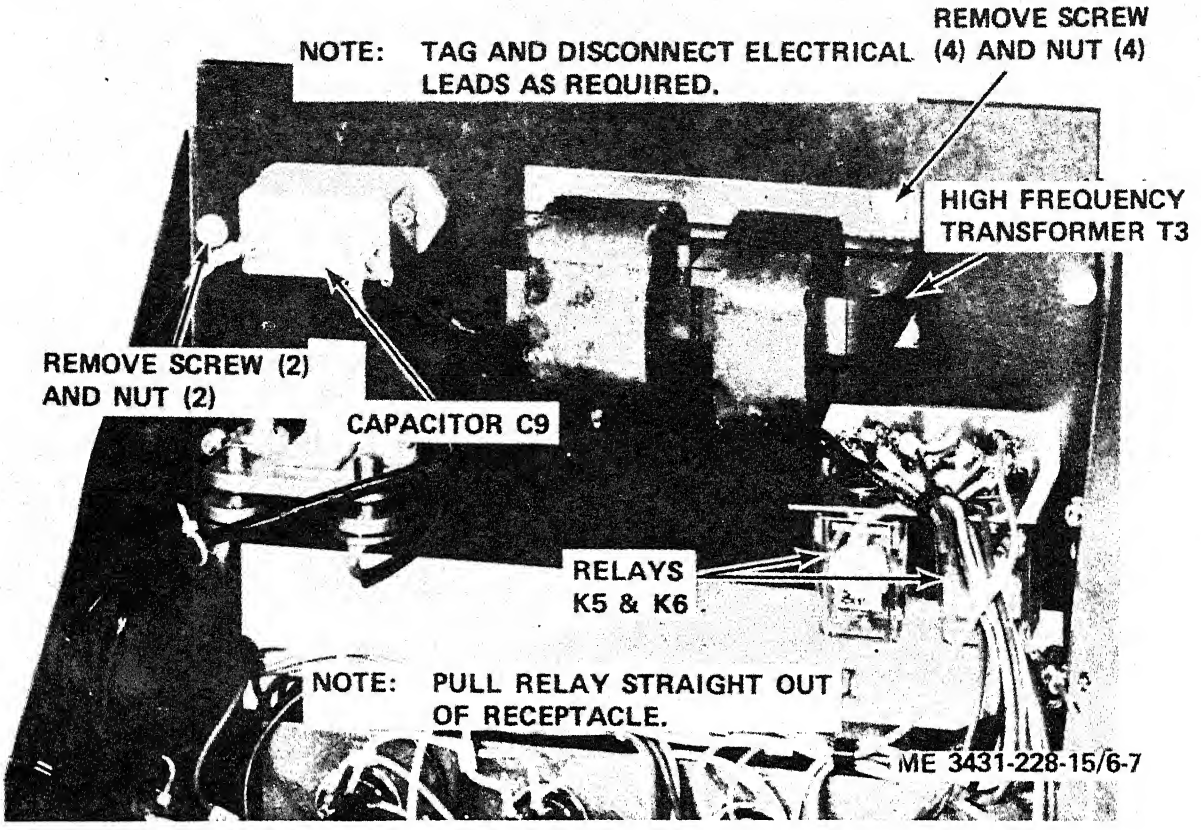


Figure 6-7. High frequency transformer T3, relays K5 and K6, and capacitor C9, removal and installation.

6-20. Tesla Coil T4

a. Removal.

(1) Disconnect ac power from the welding machine.

(2) Remove the top and housing (para 3-20).

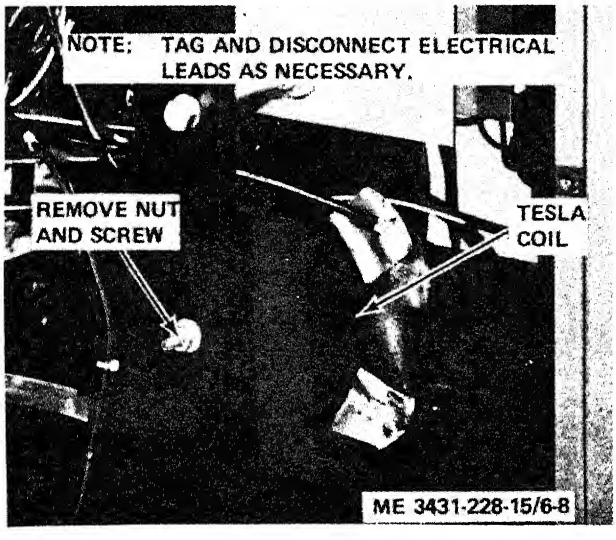


Figure 6-8. Tesla coil, removal and installation.

(3) Refer to figure 6-8 and remove the tesla coil.

b. Installation.

(1) Refer to figure 6-8 and install the tesla coil.

(2) Install the top and housing (para 3-20).

6-21. Filter Reactor L1 and Reactor Coil

a. Removal.

(1) Disconnect ac power from the welding machine.

(2) Remove timer and high frequency drawer (para 3-19).

(3) Remove top and housing from the welding machine (para 3-20).

(4) Remove the power rectifier assembly (para 6-26).

(5) Refer to figure 6-5 and remove the filter reactor or filter reactor coil.

b. Testing. Connect an ohmmeter across the reactor coil and check for an open circuit, indicating a defective coil.

c. Installation.

(1) Refer to figure 6-5 and install the coil on the core or install the filter reactor on main transformer T1.

(2) Install the power rectifier assembly (para 6-26).

(3) Install the top and housing (para 3-20).

(4) Install the timer and high frequency drawer (para 3-19).

6-22. Relays K1, K2, K3, K4, and Control Rectifier CR2

a. Removal.

(1) Remove the top and housings from the welding machine (para 3-20).

(2) Refer to figure 6-9 and remove relays K1, K2, K3, K4 and control rectifier CR2 as required.

b. Installation.

(1) Refer to figure 6-9 and install relays K1, K2, K3, K4, and control rectifier CR2.

(2) Install top and housing (para 3-20).

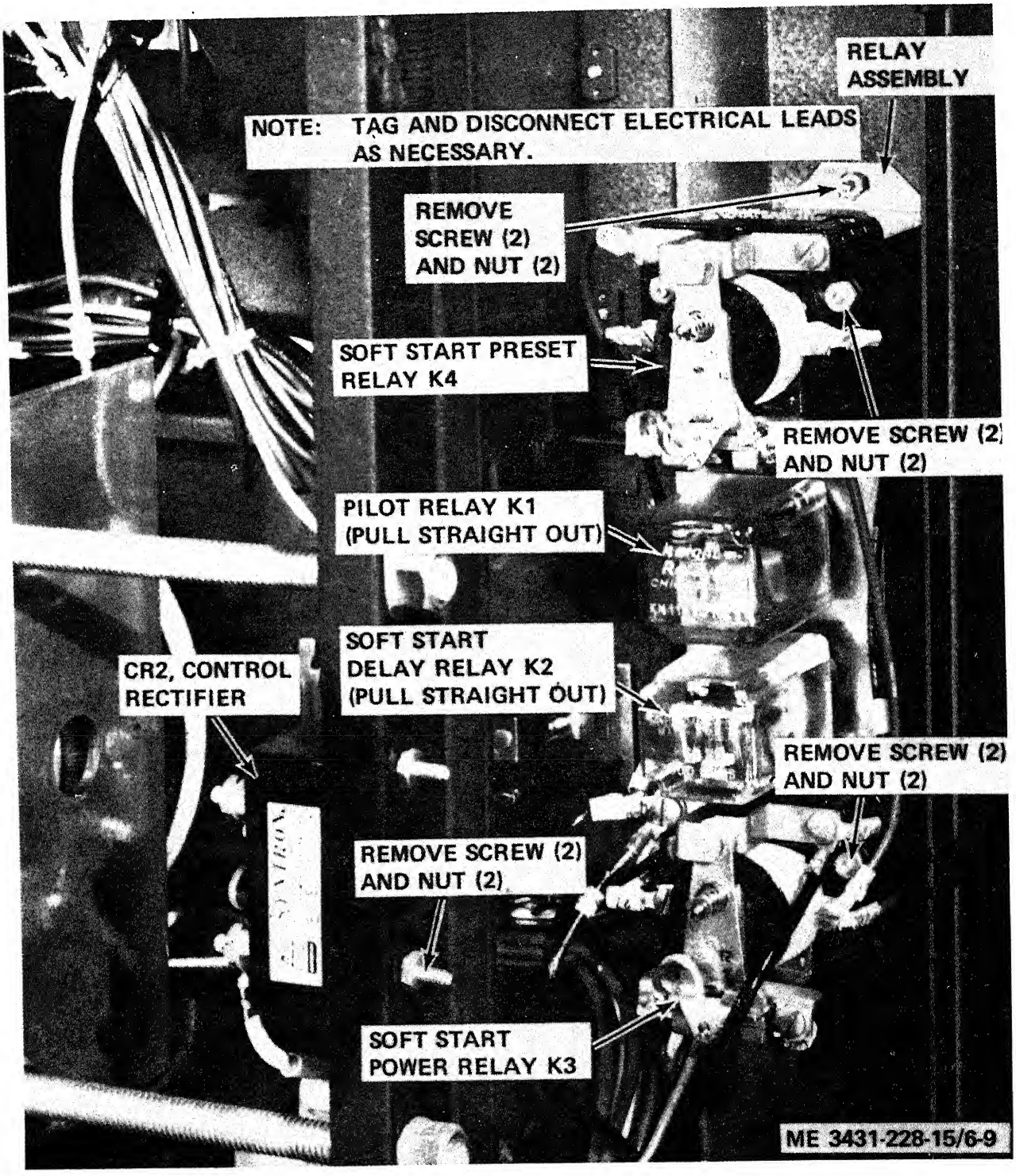


Figure 6-9. Relays K1, 2, K3, K4, control rectifier CR2, and relay assembly, removal and installation.

6-23. Pilot Rectifier CR3

a. Removal.

(1) Remove the top and housing from the welding machine (para 3-20).

(2) Refer to figure 6-9 and remove the two screws and nuts that mount the relay assembly on the front control panel.

(3) Refer to figure 6-10 and remove pilot rectifier CR3.

b. Installation.

(1) Refer to figure 6-10 and install pilot rectifier CR3.

(2) Refer to figure 6-9 and mount the relay assembly.

(3) Install the top and housing (para 3-20).

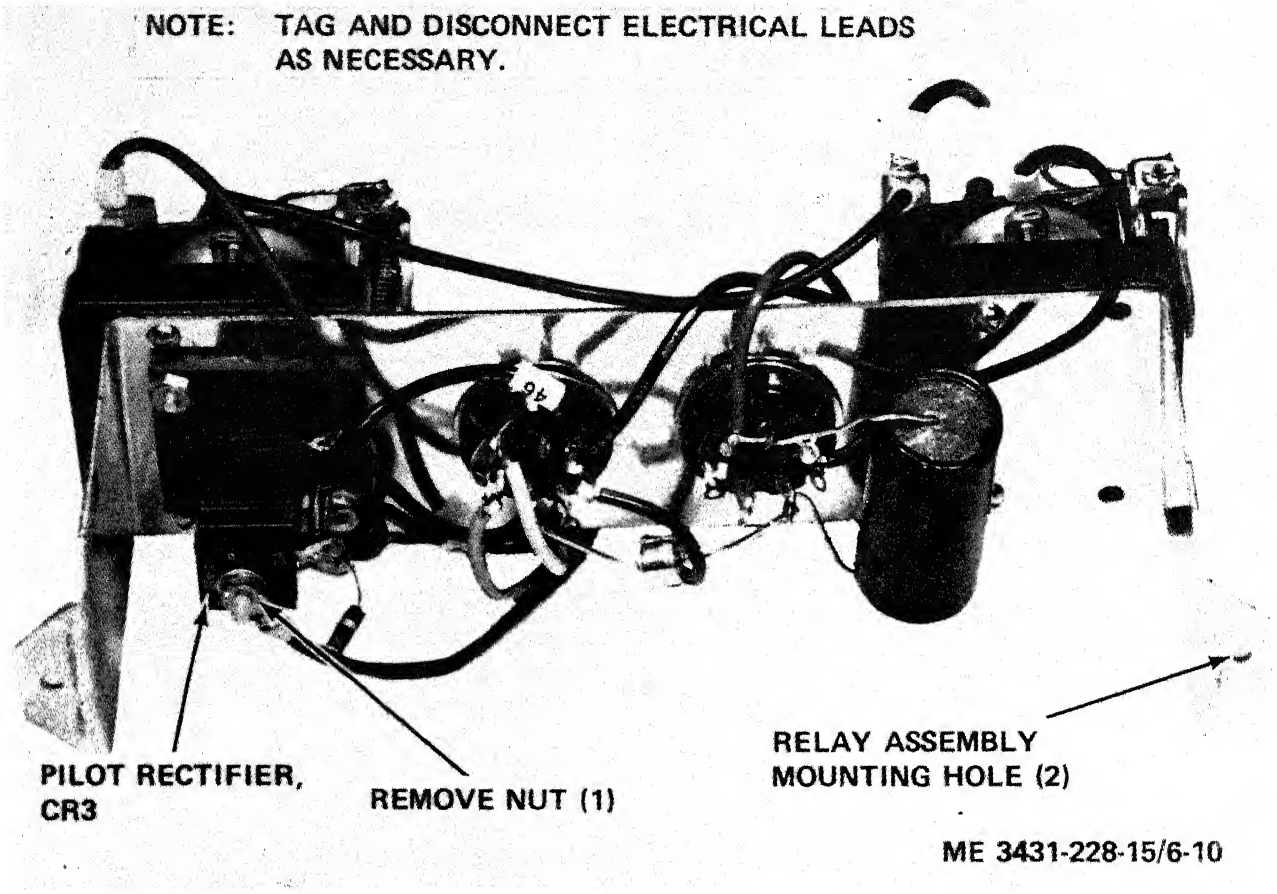


Figure 6-10. Pilot rectifier CR3, removal and installation.

6-24. Power Factor Capacitor C1

a. Removal.

(1) Remove the top and housing from the welding machine (para 3-20).

(2) Refer to figure 6-11 and remove the power factor capacitor.

b. Installation.

(1) Refer to figure 6-11 and install the power factor capacitor.

(2) Install the top and housing on the welding machine (para 3-20).

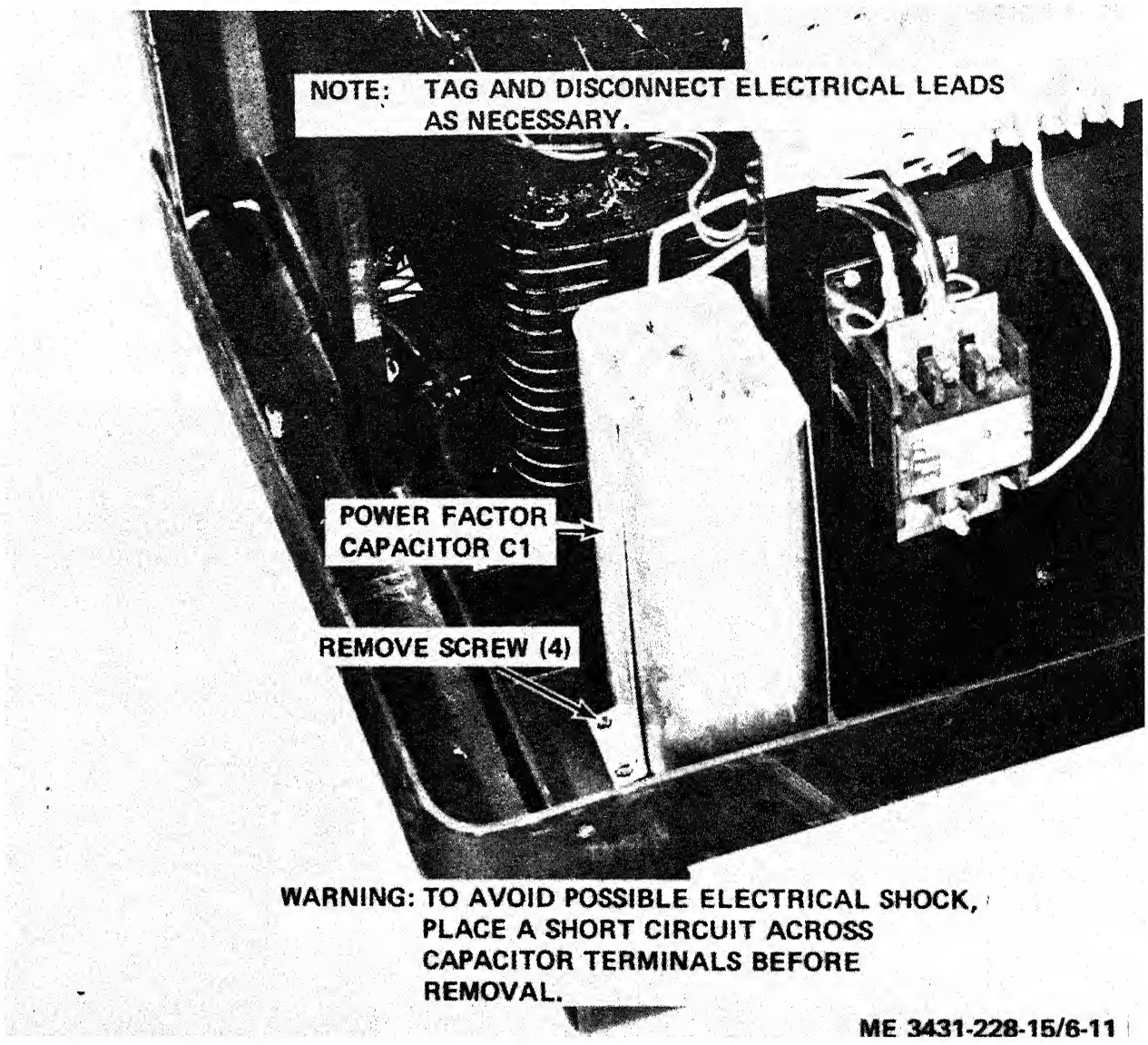


Figure 6-11. Power factor capacitor C1, removal and installation.

6-25. Filter Capacitor C7 and Resistors R3 and R4

a. Removal.

(1) Remove the top and housing from the welding machine (para 3-20).

(2) Refer to figure 6-12 and remove the filter capacitor and resistors R3 and R4.

b. Installation.

(1) Refer to figure 6-12 and install filter capacitor C7 and resistors R3 and R4.

(2) Install the top and housing on the welding machine (para 3-20).

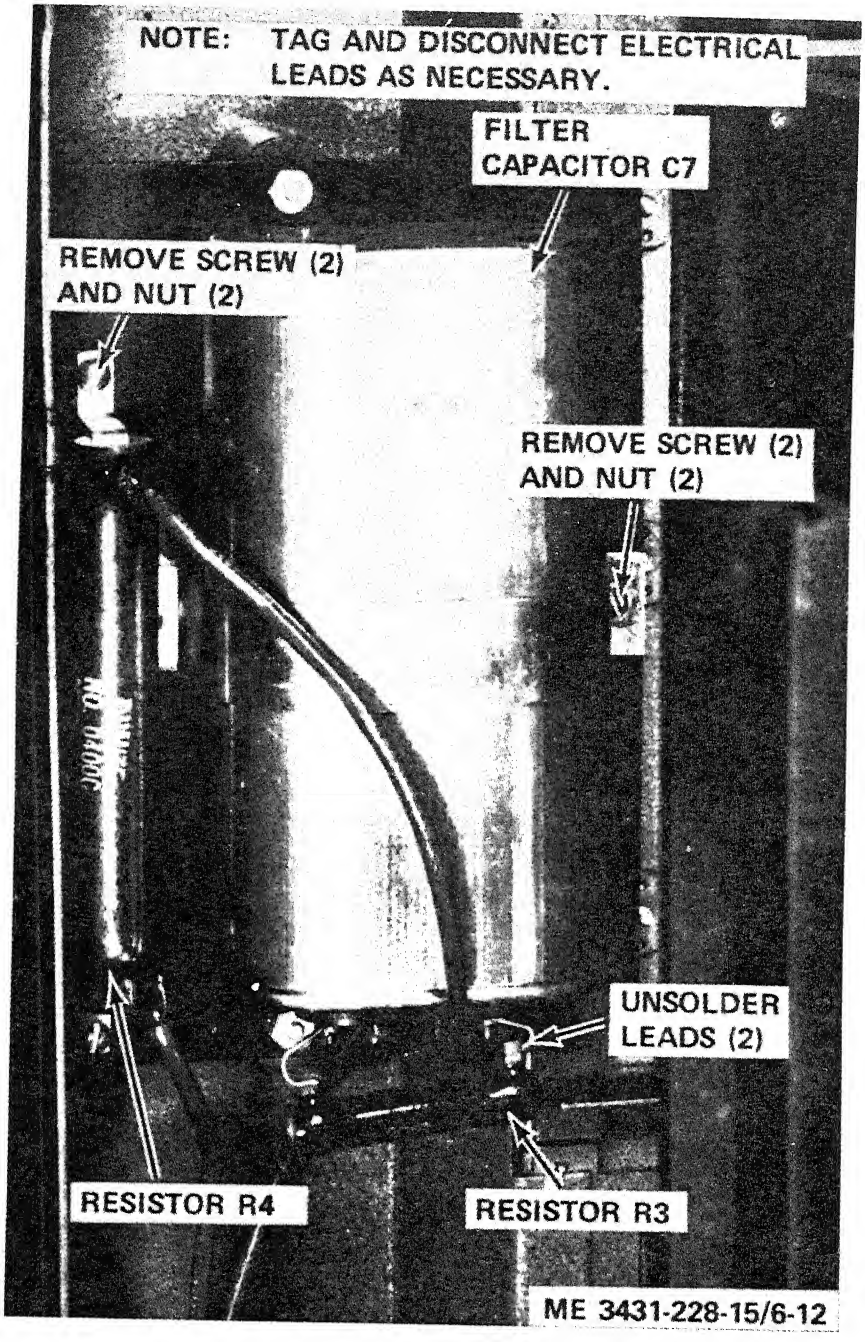


Figure 6-12. Filter capacitor C7 and resistor R3 and R4, removal and installation.

6-26. Power Rectifier Assembly, Diodes CR4-CR7

a. Removal.

(1) Remove the top and housing from the welding machine (para 3-20).

(2) Refer to figure 6-13 and remove the power rectifier assembly and remove the diodes from the heat sinks in the assembly.

b. Installation.

(1) Refer to figure 6-13 and install the diodes and install the power rectifier assembly.

(2) Install the top and housing (para 3-20).

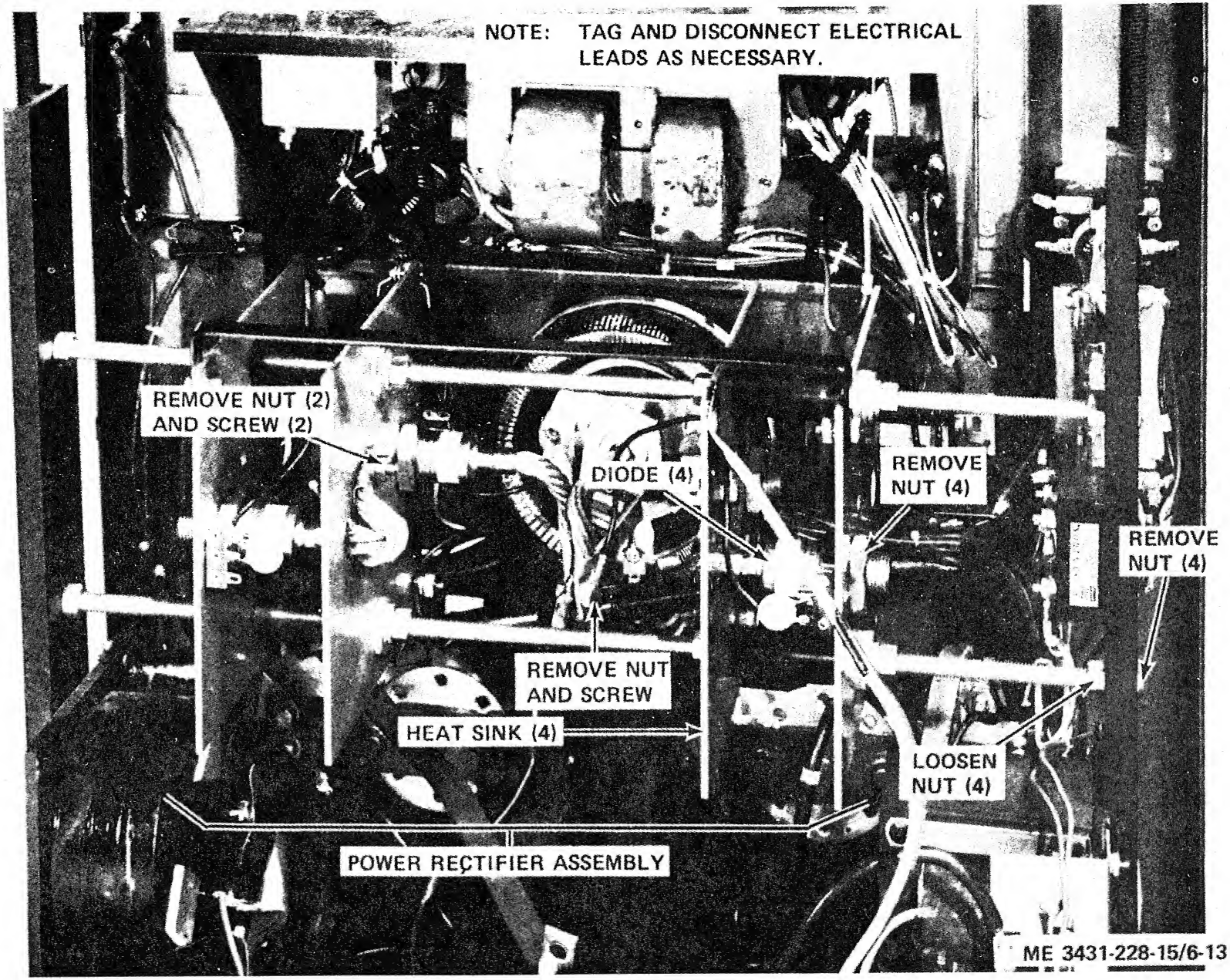


Figure 6-13. Power rectifier assembly, diodes CR4 - CR7, removal and installation.

6-27. Timer and High Frequency Drawer Wiring Harness

a. Removal.

(1) Remove the timer and high frequency drawer (para 3-19).

(2) Refer to figure 6-14 and remove the drawer wiring and wiring harness.

b. Installation.

(1) Refer to figures 6-14 and 7-1 and install the wiring harness.

(2) Install the timer and high frequency drawer (para 3-19).

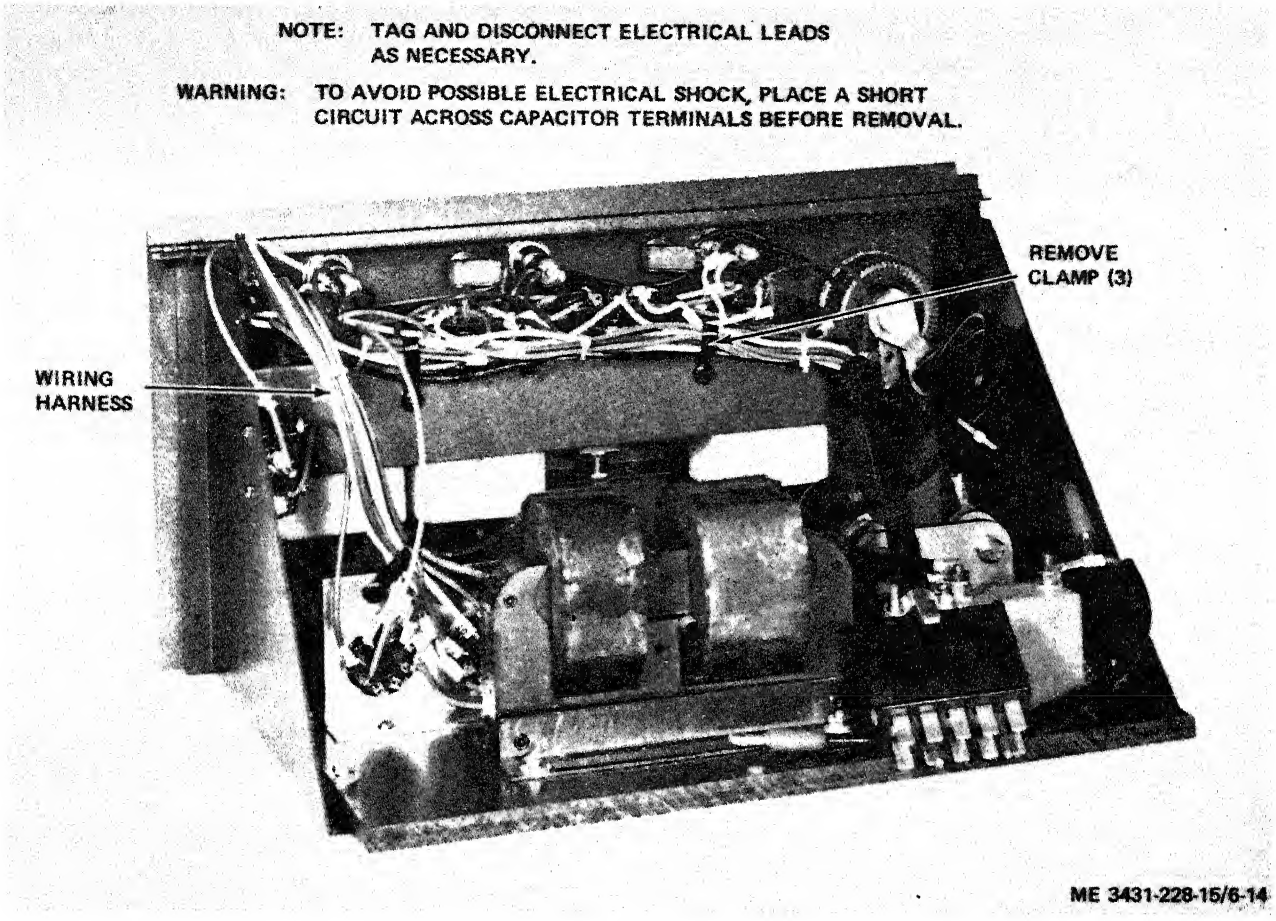


Figure 6-14. Timer and high frequency drawer harness, removal and installation.

6-28. High Frequency Capacitor C9

a. Removal.

(1) Remove the timer and high frequency drawer (para 3-19).

(2) Refer to figure 6-7 and remove the capacitor.

b. Installation.

(1) Refer to figure 6-7 and install the capacitor.

(2) Install the timer and high frequency drawer (para 3-19).

6-29. Power Relay K5 and Cntrol Relay K6

a. Removal.

(1) Remove the timer and high frequency drawer (para 3-19).

(2) Refer to figure 6-7 and remove the relays.

b. Installation.

(1) Refer to figure 6-7 and install the relays.

(2) Install the timer and high frequency drawer (para 3-19).

CHAPTER 7
REPAIR INSTRUCTIONS

7-1. Scope

This chapter contains information on repairing parts removed from the welding machine. Very few of the parts are repairable, and require replacement when malfunction occurs. Repair is limited primarily to repairing the silicon diode bridge assembly (replacing diodes) and repairing the main transofrmer T1. The schematic diagram, figure 7-2, is provided for assistance in troubleshooting and repair. Figure 7-1 is a wiring diagram of the timer and high frequency drawer.

7-2. Repairing Main Transformer T1

This complex transformer is repairable. A defective coil assembly may be replaced, but core joints must be ground open and then welded back together after the coil assembly is replaced.

Figure 7-1. Timer and High Frequency Drawer, Wiring Diagram.

(Located in back of manual)

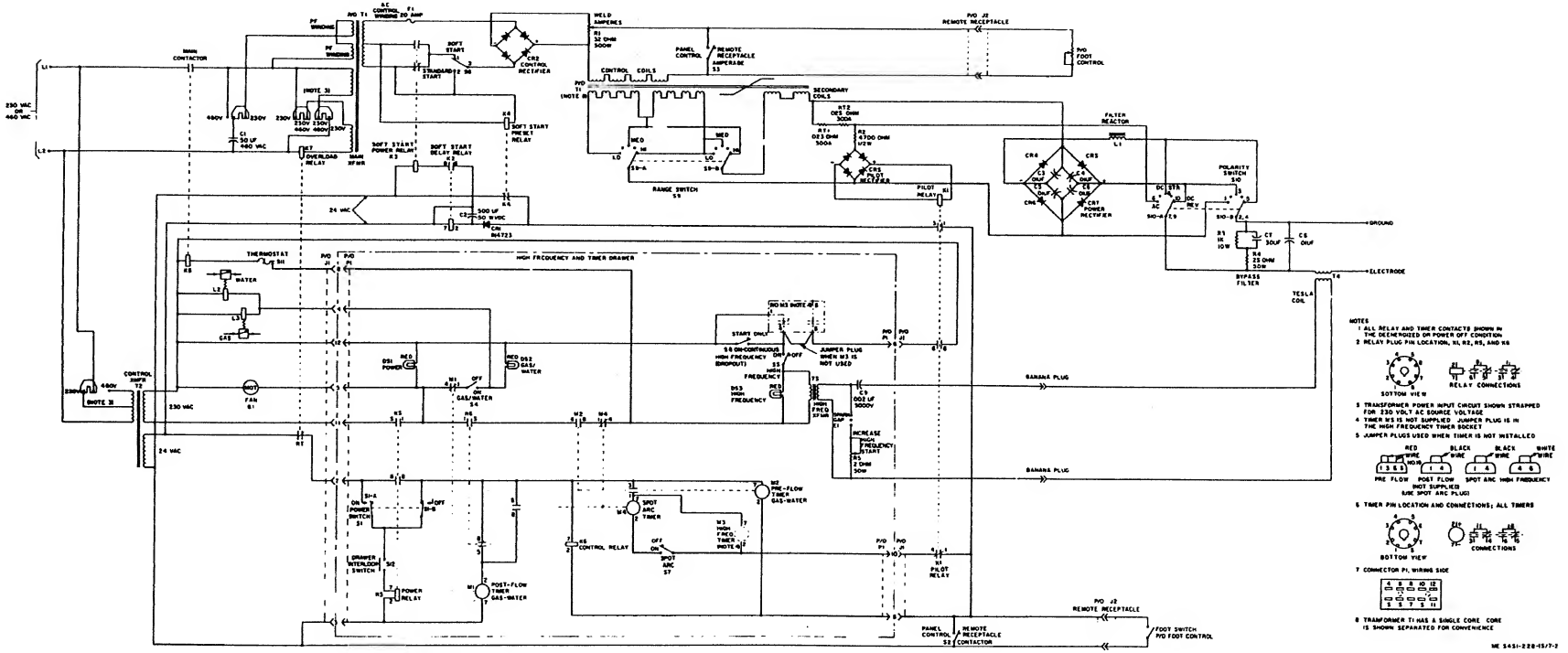


Figure 7-2. Welding Machine Schmatic Diagram.

APPENDIX A
REFERENCES

A-1. Fire Protection

TB 5-4200-200-10	Hand Portable Fire extinguishers Approved for Army Users

A-2. Lubrication

C9100IL	Fuels Lubricants, Oils and Waxes

A-3. Painting

TM 9-213	Painting Instructions for Field Use

A-4. Radio Suppression

TM 11-483	Radio Interference Suppression

A-5. Maintenance

TM 38-750	Army Equipment Procedures

A-6. Shipment and Storage

TB 740-93-2	Preservation of USAMEC Mechanical Equipment for Shipment and Storage
TM 740-0-1	Administrative Storage of Equipment

APPENDIX B
BASIC ISSUE ITEMS LIST

SECTION I. INTRODUCTION

B-1. Scope

This appendix lists items which accompany the welding machine or are required for installation, operation, or operator's maintenance.

B-2. General

This basic issue items list is divided into the following sections:

a. Basic Issue Items — Section II. A list of items which accompany the welding machine and are required by the operator/crew for installation, operation, or maintenance.

b. Maintenance and Operating Supplies — Section III. A listing of maintenance and operating supplies required for initial operation.

B-3. Explanatin of Columns

The following provides an explanation of columns in the tabular list of basic issue items, section II.

a. Source, Maintenance, and Recoverability Codes (SMR):

(1) Source code indicates the source for the listed item. Source codes are:

Code	*Explanation*
P	Repair parts which are stocked in or supplied from the GSA/DSA, or Army supply system and authorized for use at indicated maintenance categories.
P2	Repair parts which are procured and stocked for insurance purposes because the combat or military essentiality of the end item dictates that a minimum quantity be available in the supply system.
M	Repair parts which are not procured or stocked, but are to be manufactured in indicated maintenance levels.
A	Assemblies which are not procured or stocked as such, but are made up of two or more units. Such component units carry individual stock numbers and descriptions, are procured and stocked separately and can be assembled to form the required assembly at indicated maintenance categories.
X	Parts and assemblies which are not procured or stocked and the mortality of which normally is below that of the applicable end item or component. The failure of such part or assembly should result in retirement of the end item from the supply system.
X1	Repair parts which are not procured or stocked. The requirement for such items will be filled by use of the next higher assembly or component.
X2	Repair parts which are not stocked. The indicated maintenance category requiring such repair parts will attempt to obtain them through cannibalization. Where such repair parts are not obtainable through cannibalization, requirements will be requisitioned, with accompanying justification, through normal supply channels.
G	Major assemblies that are procured with PEMA funds for initial issue only as exchange assemblies at DSU and GSU level. These assemblies will not be stocked above DS and GS level or returned to depot supply level.

(2) Maintenance code indicates the lowest category of maintenance authorized to install the listed item. The maintenance level code is:

Code	*Explanation*
C	Operator/crew

(3) Recoverability code indicates whether unserviceable items should be returned for recovery or salvage. Items not coded are expendable. Recoverability codes are:

Code	*Explanation*
R	Repair parts (assemblies and components) which are considered economically reparable at direct and general support maintenance levels. When the maintenance capability to repair these items does not exist, they are normally disposed of at the GS level. When supply consideration dictate, some of these repair parts may be listed for automatic return to supply for depot level repair as set forth in AR 710-50. When so listed, they will be replaced by supply on an exchange basis.
S	Repair parts and assemblies which are economically reparable at DSU and GSU activities and which normally are furnished by supply on an exchange basis. When items are determined by a GSU to be uneconomically reparable, they will be evacuated to a depot for evaluation and analysis before final disposition.
T	High dollar value recoverable repair parts which are subject to special handling and are issued on an exchange basis. Such repair parts normally are repaired or overhauled at depot maintenance activities.
U	Repair parts specifically selected for salvage by reclamation units because of precious metal content, critical materials, or high dollar value reusable casings or castings.

b. Federal Stock Number. This column indicates the Federal stock number assigned to the item and will be used for requisitioning purposes.

c. Description. This column indicates the Federal item name and any additional description of the item required. The abbreviation "w/e", when used as a part of the nomenclature, indicates the Federal stock number, includes all armament, equipment, accessories, and repair parts issued with the item. A part number or other reference number is followed by the applicable five-digit Federal supply code for manufacturers in parenthesis. Repair parts quantities included in kits, sets, and assemblies are shown in front of the repair part name.

d. Unit of Measure (U/M). A two-character alphabetic abbreviation indicating the amount or quantity of the item upon which the allowances are based, e.g., ft, ea, pr, etc.

e. Quantity Incorporated in Unit. This column indicates the quantity of the item used in the assembly group. A "V" appearing in this column in lieu of a quantity indicates that a definite quantity cannot be indicated (e.g. shims, spacers, etc.).

f. Quantity Furnished With Equipment. This column indicates the quantity of an item furnished with the equipment.

g. Illustration. This column is divided as follows:

(1) *Figure number.* Indicates the figure number of the illustration in which the item is shown.

(2) *Item number.* Indicates the callout number used to reference the item in the illustration.

B-4. Explanation of Columns in the Tabular List of Maintenance and Operating Supplies - Section III (Not applicable)

(Not applicable).

Section II. BASIC ISSUE ITEMS

(1) SMR code	(2) Federal stock number	(3) Description	(4) Unit of meas	(5) Qty inc in unit	(6) Qty furn with equip	(7) Illustration	
						(A) Fig No.	(B) Item No.
		GROUP 31–BASIC ISSUE ITEMS, MANUFACTURER INSTALLED					
		3100–Basic Issue Items, Manufacturer or Depot Installed					
PC	7520-559-9618	Case, Maintenance and Operational Manuals: cotton duck, water repellant, mildew resistant	EA		1		
		Department of the Army, Operator, Organizational, Direct and General Support, Maintenance Manual TM 5-3431-228-14	EA		1		
		GROUP 32–BASIC ISSUE ITEMS, TROOP INSTALLED					
		3200–Basic Issue Items, Troop Installed or Authorized					
PCR	4210-555-8837	Extinguisher, Fire, Monobromotri-fluoromethane	EA		*		
PC	5975-878-3791	Rod Assembly, Ground: 3 Sect.; 9 ft. lg.; 5/8 in. d.a.; copper coated; cone point, separable clamp; w/6 ft. wire and one terminal end	EA		*		

APPENDIX C
MAINTENANCE ALLOCATION CHART

Section I. INTRODUCTION

C-1. General

a. This section provides a general explanation of all maintenance and repair functions authorized at various maintenance levels.

b. Section II designates overall responsibility for the performance of maintenance functions on the identified end item or component. The implementation of the maintenance functions upon the end item or component will be consistent with the assigned maintenance functions.

c. Section III lists the special tools and test equipment required for each maintenance function as referenced from Section II.

d. Section IV contains supplemental instructions, explanatory notes and/or illustrations required for a particular maintenance function.

C-2. Explanation of Columns in Section II

a. Group Number, Column (1). The assembly group is a numerical group assigned to each assembly in a top down breakdown sequence. The applicable assembly groups are listed on the MAC in disassembly sequence beginning with the first assembly removed in a top down disassembly sequence.

b. Functional Group, Column (2). This column contains a brief description of the components of each assembly group.

c. Maintenance Functions, Column (3). This column lists the various maintenance functions (A through K) and indicates the lowest maintenance category authorized to perform these functions. The symbol designations for the various maintenance categories are as follows:

C — Operator or crew
O — Organizational maintenance
F — Direct support maintenance
H — General support maintenance
D — Depot maintenance

The maintenance functions are defined as follows:

A — Inspect. To determine serviceability of an item by comparing its physical, mechanical, and electrical characteristics with established standards.

B — Test. To verify serviceability and to detect electrical or mechanical failure by use of test equipment.

C — Service. To clean, to preserve, to charge, and to add fuel, lubricants, cooling agents, and air. If it is desired that elements, such as painting and lubricating, be defined separately, they may be so listed.

D — Adjust. To rectify to the extent necessary to bring into proper operating range.

E — Align. To adjust specified variable elements of an item to bring to optimum performance.

F — Calibrate. To determine the corrections to be made in the readings of instruments or test equipment used in precise measurement. Consists of the comparison of two instruments, one of which is a certified standard of known accuracy, to detect and adjust any discrepancy in the accuracy of the instrument being compared with the certified standard.

G — Install. To set up for use in an operational environment such as an emplacement, site, or vehicle.

H — Replace. To replace unserviceable items with serviceable like items.

I — Repair. Those maintenance operations necessary to restore an item to serviceable condition through correction of material damage or a specific failure. Repair may be accomplished at each category of maintenance.

J — Overhaul. Normally, the highest degree of maintenance performed by the Army in order to minimize time work in process is consistent with quality and economy of operation. It consists of that maintenance necessary to restore an item to completely serviceable condition as prescribed by maintenance standards in technical publications for each item of equipment. Overhaul normally does not return an item to like new, zero mileage, or zero hour condition.

K — Rebuild. The highest degree of materiel maintenance. It consists of restoring equipment as nearly as possible to new condition in accordance with original manufacturing standards. Rebuild is performed only when required by operational considerations or other paramount factors and then only at the depot maintenance category. Rebuild reduces to zero the hours or miles the equipment, or component thereof, has been in use.

d. Tools and Equipment, Column (4). This column is provided for referencing by code the special tools and test equipment, (sec. III) required to perform the maintenance functions (sec. II).

e. Remarks, Column (5). This column is provided for referencing by code the remarks (sec. IV) pertinent to the maintenance functions.

C-3. Explanation of Columns in Section III

a. Reference Code. This column consists of a number and a letter separated by a dash. The number references the T&TE requirements column on the MAC. The letter represents the specific maintenance function the item is to be used with. The letter is representative of columns A through K on the MAC.

b. Maintenance Category. This column shows the lowest level of Maintenance authorized to use the special tool or test equipment.

c. Nomenclature. This column lists the name or identification of the tool or test equipment.

d. Tool Number. This column lists the manufacturer's code and part number, or Federal Stock Number of tools and test equipment.

C-4. Explanation of Columns in Section IV

a. Reference Code. This column consists of two letters separated by a dash, both of which are references to Section II. The first letter references column 5 and the second letter references a maintenance function, column 3, A through K.

b. Remarks. This column lists information pertinent to the maintenance function being performed, as indicated on the MAC, Section II.

Section II. MAINTENANCE ALLOCATION CHART

(1) Group No.	(2) Functions group	(3) Maintenance functions A Inspect	B Test	C Service	D Adjust	E Align	F Calibrate	G Install	H Replace	I Repair	J Overhaul	K Rebuild	(4) Tools and equipment	(5) Remarks
01	HOUSING AND FRAME SUPPORT:													
	Lifting eye	C							O					
	Cover, top	C							O	O				
	Panels, housing	C							O	O				
	Base assembly	O							H	O				
02	VENTILATING SYSTEM:													
	Motor, fan	O							O					
	Guard assembly, fan	O		O					O	O				A
	Blade, fan	O							O					
03	CONTROL PANELS:													
	Main control panel								F	F				
	Switches: remote contactor & amperage, soft start	C							O					
	Switches: range & polarity	C							F	F				
	Rheostat, control		F						F					
	Receptacle, remote control	C							O					
	Drawer, high frequency								O	F				
	Spark gap assy	O		O	O				O	O				B
	Switches	C	O						O					
	Capacitor		F						F					
	Rheostat		F						F					
	Relay		F						F					
	Transformer, high frequency		F	O					F					C
	Indicator lamps	C							O					
04	CONNECTING DEVICES:													
	Change bars				O				O					
	Terminal boards	O							O					
	Wiring assembly	O	F						F	F				
	Cables, ground & electrode	C							O					
	Holder, electrode	C							O	O				
	Clamp, ground	C							O					
05	PROTECTIVE DEVICES:													
	Switches, thermostatic		O						O					
	Fuses & holders	C	O						O					
06	RECTIFIER COMPONENTS:													
	Rectifier, main		O	O					F	F				D
	Rectifier, control		O	O					F					D
07	TRANSFORMER COMPONENTS:													
	Transformer, main		H	O					H	H				C
	Transformer, control		F	O					F	H				C
	Stabilizer		F						F					
	Coil, tesla		F						F					
	Filter reactor		F						F	H				
08	SWITCHING, TIMING AND SPEED CONTROL:													
	Timers		O						O					
	Relays		F						F					
	Contactors	O	O						O					
	Valves, solenoid		O						O					
	Capacitors		F						F					
09	RESISTORS		F						F					
10	CONTROL ASSEMBLY, REMOTE FOOT	O	O						O	F				
11	DATA PLATES													
	Plates, identification	C							F					
	Plates, cuation & instruction	C							O					

Section III. SPECIAL TOOL AND SPECIAL EQUIPMENT REQUIREMENTS

Reference code	Maintenance category	Nomenclature	Tool number
		No special tools or test equipment required.	

Reference Code	Remarks
A–C	Clean screen by blowing out with compressed air.
B–D	Set gap at .008 inches.
C–C	Remove dust and dirt with clean, dry air stream.
D–C	Clean periodically by blowing out with dry, compressed air. Blow through and not across the rectifier plates.
E–I	Fabricate

ALPHABETICAL INDEX

By Order of the Secretary of the Army:

W. C. WESTMORELAND,
General, United States Army,
Chief of Staff.

Official:

KENNETH G. WICKHAM,
Major General, United States Army,
The Adjutant General.

Distribution:

To be distributed in accordance with DA Form 12-25, Section I, (qty rqr block no. 181) Operator maintenance requirements for Equipment: Welding.

*U.S.GOVERNMENT PRINTING OFFICE:1989-0-242-451(06142)

NOTES:

1. THE SMALL NUMBER ON EACH WIRE CORRESPONDS TO THE LARGE NUMBER ADJACENT TO THE STATION.
2. (S) INDICATES WIRE COVERED WITH FIBERGLASS SLEEVING.
3. BS INDICATES BARE WIRE.

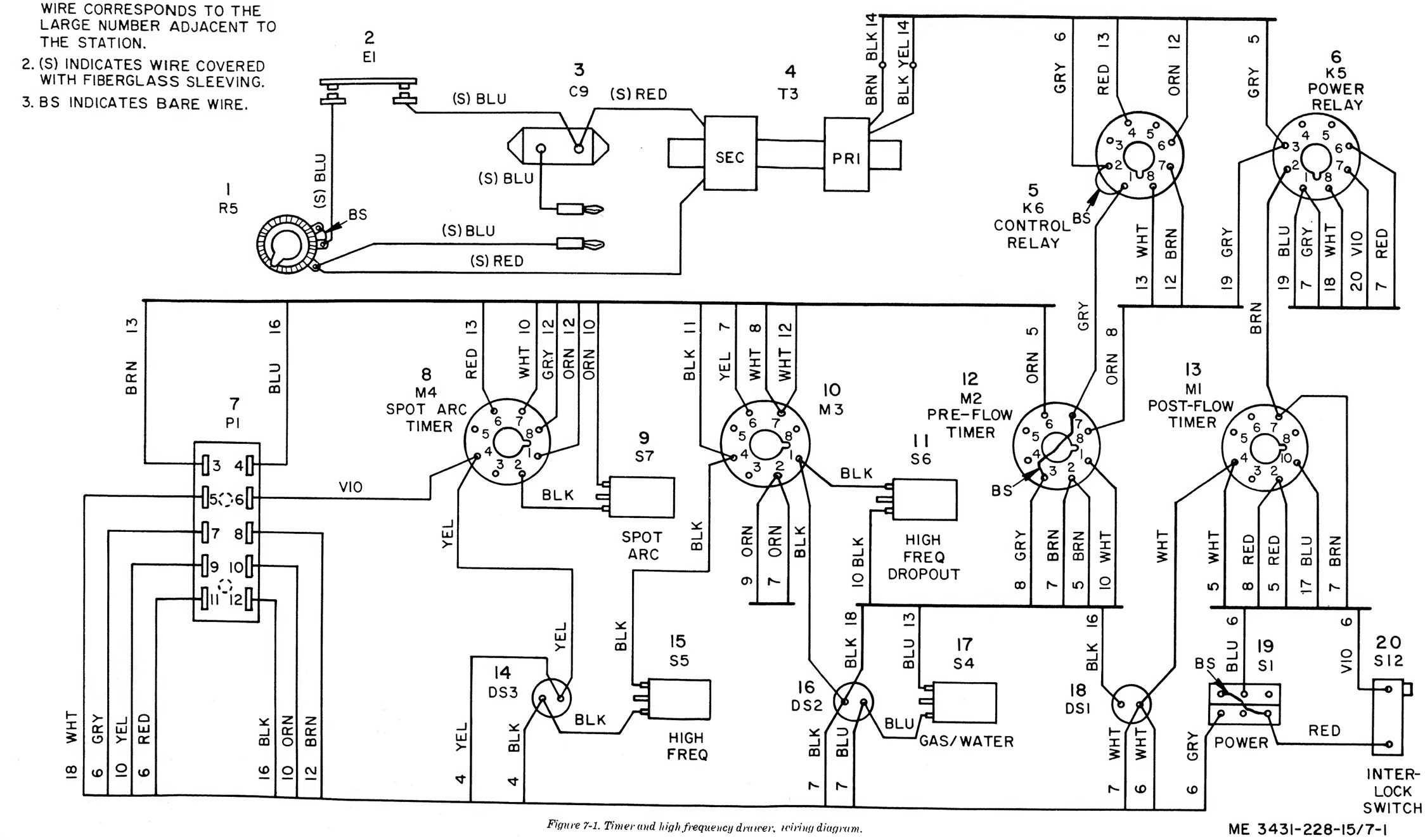


Figure 7-1. Timer and high frequency drawer, wiring diagram.

ME 3431-228-15/7-1